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# SUPERCAR ON SKIS

A Biofuel-Powered Hot Rod Built for Antarctica

# #3: LEECH BAIT

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# POPULAR SCIENCE

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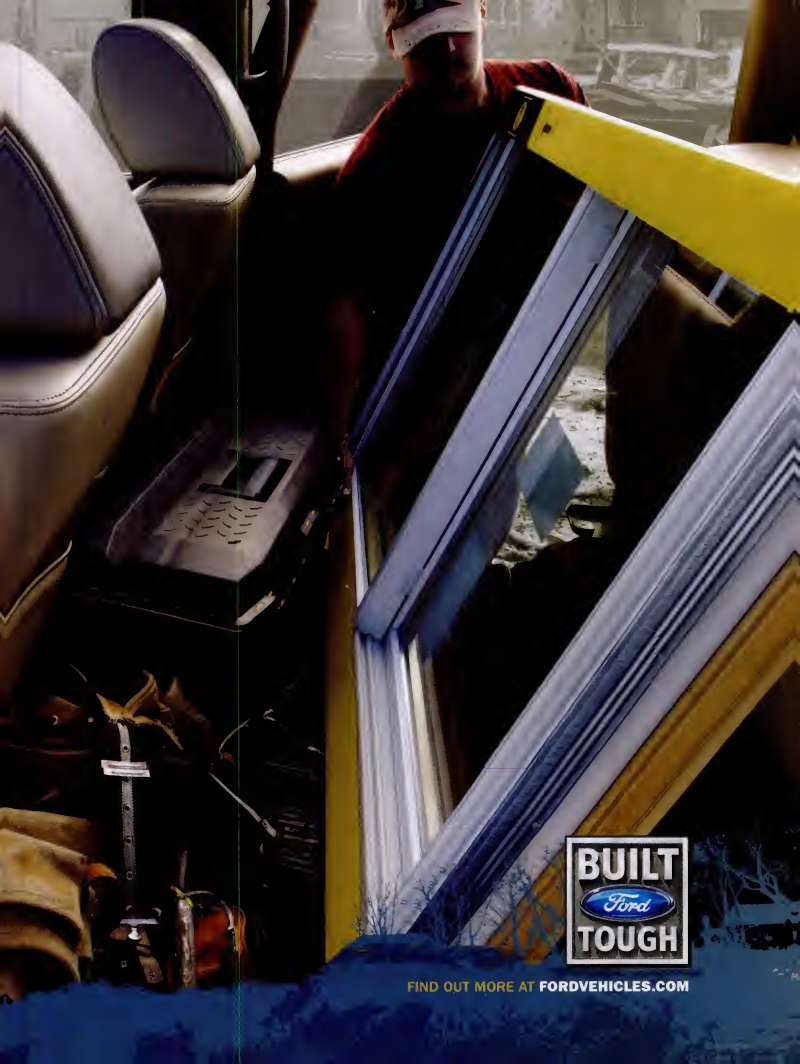
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FEBRUARY '09

VOLUME 274 #2

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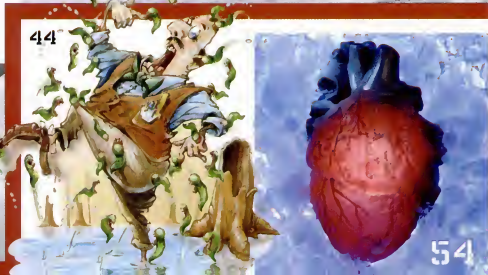
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THE  
FUTURE  
NOW



**JACKPOT** We pick winning gadgets from the year's biggest tech convention.

## WHAT HAPPENS IN VEGAS . . .

. . . gets beamed straight to you. PopSci will be reporting live from January's Consumer Electronics Show, bringing you up-to-the-minute coverage of the gadgets, tech trends and announcements that you'll be talking about for the rest of the year. See photos of the biggest TVs, videos of the wildest robots, and blog posts about tech-celebrity sightings, at [popsci.com/ces2009](http://popsci.com/ces2009).



## BLOGS AND MORE

### MOTOR CITY ROLLS ON

What cars will be introduced post-bailout? We'll report on the hits and misses of the annual Detroit Auto Show. Check out photos and news at [popsci.com/detroit](http://popsci.com/detroit).



### OF MARS AND MEN

If Robert Zubrin has his way, we'll have colonies on Mars in the near-ish future. Read about his ambitious space-exploration ideas at [popsci.com/marscolony](http://popsci.com/marscolony).

### GEEKED-OUT SWEETHEARTS

Nothing says "love" like a gadget. Before you hit the stores this Valentine's Day, make sure you're getting your special someone what he or she *really* wants. Check out our gift guide, full of swoon-worthy phones, MP3 players and more at [popsci.com/valentines](http://popsci.com/valentines)



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**GLAMOROUS AS I'M CERTAIN** the job of PopSci editor-in-chief must seem, most of my days are spent navigating the classic treadmill of subway to work, nine hours or so staring into a computer screen, then home for a few precious hours with my family and off to bed. So I confess to experiencing a discomf-

ROSSY'S PASSION  
CARRIES HIM  
BEYOND THE  
BOUNDS OF WHAT  
OTHER PILOTS  
CONSIDER SANE.

ing flash of self-recognition when I read the following quote in Eric Hagerman's soaring profile of Yves Rossy [page 36]: "In French we say *metro, boulot, dodo*: subway, work, sleep. If all people are like this, we are like sheep and nothing comes better. And we need some people like Yves."

Yves Rossy, the 49-year-old Swiss "jet man" on this month's cover, who recently flew across the English Channel strapped into a jet-powered wing of his own design, is not, shall we say, like a sheep. "He is the PopSci poster child," says Hagerman, a former senior editor here who appreciates the core qualities of the POPULAR SCIENCE spirit. "He's a practical dreamer. He's capable in his own right as a pilot, but he has this passion for technology that carries him well beyond the bounds of what most people in his profession consider doing—or even consider sane."

Rossy's dream involves not just painstakingly perfecting the technology that lets him join the birds in escaping the tethers of terra firma, but—and this is where it gets truly quixotic—making his jet wing so safe and intuitive to operate that you and I can do the same. Hagerman, to his own surprise, caught the personal-flight bug while reporting the story: "I'm not particularly fond of heights," he says. "And on several occasions I've said to people, 'You'll never catch me jumping out of an airplane.'" But in an effort to understand the feeling that drives Rossy's quest, that's just what he did. And as soon as he touched down safely on earth, he wanted to go back up. "I would not have predicted that," he says.

When I was younger, a recurring dream gifted me with the power to simply spread my arms, float off the ground, and fly. I loved that dream, but I haven't had it in a long time. Maybe it's the effect of all that *metro, boulot, dodo*. And that is why, yes, we need some people like Yves Rossy.

MARK JANNOTT

mark.jannott@bonniercorp.com



# THE TRUTH BEHIND FOOD FOLKLORE

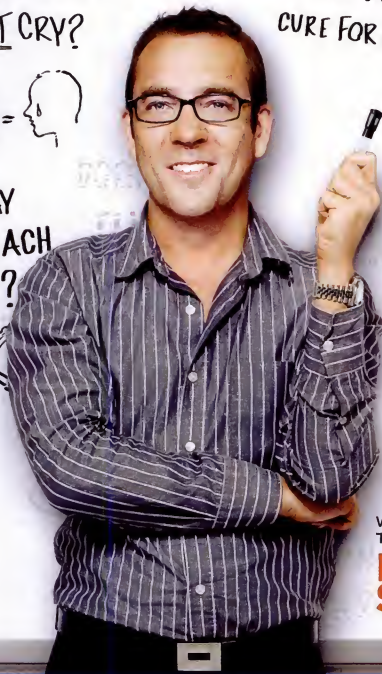
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AND NOT CRY?



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IN YOUR STOMACH  
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## OH MY OLED!

Our Innovation of the Year—announced in December's "Best of What's New" issue—rarely fails to spark heated debate among tech fans. This year's winner, the Sony XEL-1 OLED television, was no exception. Online readers were especially divided. **"Once a TV gets thinner than an inch, what's the real practical advantage?"** asked Ford2go, who summed up the television as "a classic case of 'mine's thinner than yours.'" Other commentators were quick to point out that the set has more merits than just its svelte good looks. **"The better contrast ratios make it superior to**

## THIS SEEMS LIKE A CLASSIC CASE OF 'MINE'S THINNER THAN YOURS.'

**LEDs,"** Joenz wrote. One reader who had the chance to see the TV in person testified to its stunning picture quality. **"The colors are brilliant and vivid, and the blacks are pitch-black,"** he commented. "I'm really waiting until Sony improves the lifetime, lowers the price, and increases the size." And Caradoc01 was feeling particularly visionary: **"Expect to soon see OLEDs on the sides of buses and ultimately on billboards."** Add your two cents at [popsci.com/bown/2008](http://popsci.com/bown/2008).

## Corrections

Nissan's Web site ["The Best of What's New: Auto Tech," Dec. 2008] should have been listed as [nissanus.com](http://nissanus.com).

The SensAble Dental Lab is not the first with a 3-D printer ["The Best of What's New:

Personal Health"] but the first haptic feedback system for designing dentures.

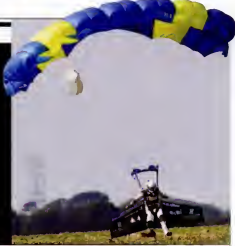
The Bahrain World Trade Center wind turbines are not 1,200-megawatt units ["The Best of What's New: Engineering"]. They are rated for only 225 kilowatts

each but together will produce about 1,200 megawatt-hours of electricity a year.

Glen Wurden is the Fusion Energy Sciences program manager at Los Alamos National Laboratory ["This Machine Might Save the World," Jan. 2009].

## NOTES FROM THE FIELD

While trailing daredevil inventor Yves Rossy for "Wingman" [page 36], contributing editor Eric Hagerman jumped out of an airplane with the Para Club Valais, a parachuting league in Switzerland. "I won't say that parachuting changed my life," he says, "but it certainly seems to have had a profound impact on these people who have devoted themselves to it. There's a French word, *sage*, that roughly translates to being calm and cool. The members of the Para Club Valais are the very definition of *sage*."



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# MEGAPIXELS

THE MUST-SEE PHOTOS OF THE MONTH

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN





# LET'S DO THE TWIST

## SCIENTISTS BUILD STRETCHY CIRCUITS

Silicon wafers, the backbone of the electronics industry, are brittle and fragile. So researchers have sought to create a more supple polymer surface that can be stretched, twisted, and bent in any direction and to populate it with newly engineered circuits. The solution: "pop-up" wire connections between the circuit components, along with flexible S-curves in the wires that can unwind and slip back into shape. "We are now the first to produce a way to stretch electronic components up to 140 percent," says Yonggang Huang, an engineering professor at Northwestern University and the co-leader of the project with John Rogers, an engineering professor at the University of Illinois. Mountable on most surfaces, flexible technology may eventually be found in displays that you can wrap around your arm, as well as solar panels on car bodies, building windows, and even an implantable camera shaped like a human eye. BY GREG SOLTIS  
PHOTOGRAPHS BY JOHN A. ROGERS



This One



U6Z4-XLO-50GH

**FOR THE HORDE** After consuming the *E. coli*, the dense, rippling mass of *M. xanthus* bacteria [facing page] morphs into a looser formation. The *M. xanthus* clusters [below] await their next victim.

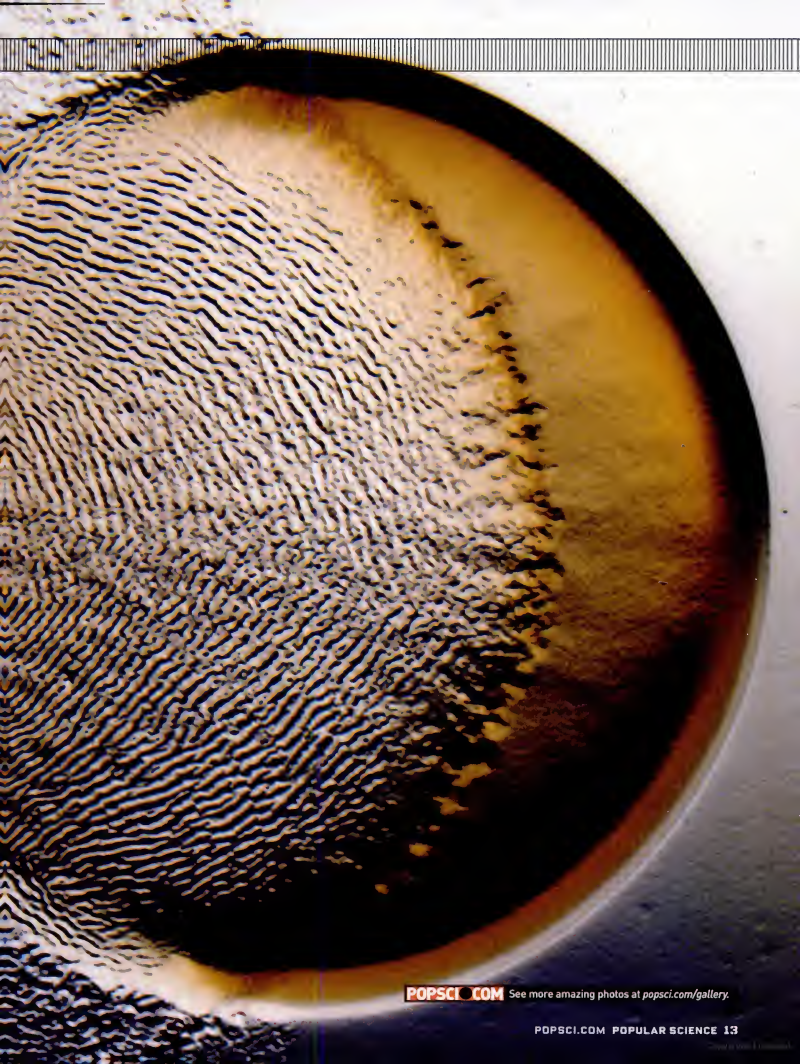
## CLUSTER'S LAST STAND

ripples reveal the highly organized behavior of thousands of cells working together to digest their prey

The waning black crescent on the facing page is all that remains from an *Escherichia coli* sample. "If it could scream, it would," says University of Iowa microbiologist John Kirby, who led a recent study on bacteria behavior. The *E. coli* has fallen victim to *Myxococcus xanthus*, a type of bacteria that forms unique rippling waves as it feasts on other bacteria. During an attack, *M. xanthus* secretes enzymes to break down *E. coli*, and then each bacterium

moves back and forth like a vacuum cleaner to suck up its food. Kirby coined the term "predataxis" to refer to behavior—in this case, the rippling—that is altered by the presence of prey. He thinks *M. xanthus* could provide a nontoxic way to get rid of unwanted microorganisms: "I can imagine that even antibiotic-resistant bacteria might be dealt with by a natural predator."

BY GREG SOLTIS PHOTOGRAPH BY JAMES BERLEMAN AND JOHN R. KIRBY



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# WHAT'S NEW

TECH THAT PUTS THE FUTURE IN THE PALM OF YOUR HAND



**18**

A hot PC that keeps its cool



**20**

Shoot the brightest home movies yet



**22**

A car that wakes you up when you doze off

## THE UNIVERSE MADE SIMPLE

THIS TELESCOPE FINDS THE STARS FOR YOU

Take a guided tour of the cosmos, led by a robotic telescope. Meade's ETX-LS is the first scope to automatically point itself at interesting celestial bodies, no human help required. As an extra benefit for beginners, it plays an informational audio clip through its speaker (for a video clip if you plug it into a monitor) once it locks on a worthy star.

Other computerized telescopes can navigate the heavens, but only after you aim them at reference stars so they can orient themselves in space. The ETX-LS automates even this step, picking out glowing dots with a camera instead of your fallible eyes. First a motor turns the scope to the approximate patch of sky where a reference star should appear, as calculated by a built-in compass and GPS receiver. Then the ETX-LS snaps a picture with its 0.3-megapixel camera sensor. It searches the shot for a fleck of the correct brightness to home in on the reference star. Bonus: That same camera can also take snapshots of your extraterrestrial sightseeing.—KER THAN

### MEADE ETX-LS

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Up to 500x

**BATTERY LIFE:** 3 to 5 hrs.

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**WEIGHT:** 30 lbs.

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## WHAT'S NEW

### THICK SLICE

This shredder won't jam even if stuffed with crumpled sheets. The blades are angled to pull pages toward the center, where the cutter's higher torque can churn through bunches up to 12 sheets thick. **Staples M5 MailMate \$90; staples.com**



# THE GOODS

## 12 MUST-HAVE PRODUCTS



### LOW-PRICED HI-FI

Slip these silicone covers over cheap earbuds to make them both fit and sound like pricier versions. Their cone shape directs waves into your ear canal; flexible ridges seal out noise. **Burton Technologies Acoustibuds \$13; acoustibuds.com**

### CALLING INFORMATION

The N97 cellphone lets you customize a home screen of widgets (software that displays constantly updated snippets of info) like weather forecasts and Facebook feeds. **Nokia N97 Price not set; nokiausa.com**

### TALKING BACKUP

Know when your emergency power will run out. Plug gadgets into the outlets on this 450-watt battery, and it calculates their draw, determines how long it can run them, and announces the result through a speaker. **Duracell Powerpack 450 \$170; duracellpower.com**



### CAMERA ROLLING

Use any Web browser to steer the Spyball Wi-Fi robot and its built-in video camera from afar. It cuts sharp turns by spinning its two powered wheels at different speeds. A smaller wheel flips out of the back to provide stability. **WowWee Spyball Price not set; wowwee.com**



### THE GREAT EQUALIZER

This TV automatically turns down the volume during blaring commercials and other deafening clips. Its audio processor is the first with SRS TruVolume, which lowers the decibel level when it senses ear-piercing frequencies, such as high notes. **Vizio VF550XVT 55-inch FHD TV \$2,000; vizio.com**





### A SEAT FOR SLOUCHERS

This chair supports both pristine posture and fidgety contortions. The back, made of flexible glass-reinforced nylon bars, conforms to your shape even if you sit side-saddle. The rubbery top bends if you hang your arm over it. **Steelcase Cobi \$585; steelcase.com**



### A HANDHELD THEATER

The Pico may not be the first mini-projector, but it's hands-down the slimmest. The four-ounce box creates 60-inch images the same way many office models do—by bouncing light off a mirrored DLP chip—but uses a 0.17-inch chip and replaces bulky lamps with colored LEDs. **Optoma Pico P106 \$400; optomausa.com**

POPSCI PICK OF THE MONTH



### MOBILE KODAK MOMENT

The first phone with a Kodak camera includes features usually found only in stand-alone shooters, such as software that brightens colors. See our tests at [popsci.com/ZN5](http://popsci.com/ZN5). **Motorola Motozine ZN5 \$350; motorola.com**

### MIXED MEDIA

Wirelessly send video to your TV from a PC, Mac, Linux computer, networked storage disk or all of the above using the only streamer that works with all these systems. It finds clips on each device and displays their names in one easily searchable menu. **Netgear Digital Entertainer Elite \$400; netgear.com**



### SEEING DOUBLE

View all your computer windows at once. At the touch of a button, an extra LCD slides out from behind this laptop's main 17-inch display, adding 40 percent more screen space. **Lenovo ThinkPad W700 DS Mobile Workstation \$3,660; lenovo.com**

### DAY RIDER

The Gemini visor, built for Akuma motorcycle helmets, darkens at a button-press for instant shade. A one-color LCD inside turns from clear to amber within a tenth of a second. **Akuma Gemini Tinted Visor \$180; akumahelmets.com**



FOUR  
FEATURES

# THE STRONG, SILENT TYPE

## LAPTOP PARTS MAKE A QUIET, ENERGY-EFFICIENT GAMING PC

Hewlett-Packard's Firebird looks like any high-powered desktop computer. But it whispers at less than 30 decibels, while rivals are twice as loud. It gets its muscle from a high-power

desktop CPU with four processors, but laptop-style components, including three graphics cards and a pair of hard drives, keep the Firebird cool, quiet and efficient.—SEAN CAPTAIN

### 1. VIDEO ON DEMAND

A graphics chip on the motherboard handles e-mail and Web pages. For 3-D gaming or Photoshop, turn on a pair of Nvidia GeForce 9800S cards. Built with chips that come from the factory with a thinner layer of metal-oxide conductor, the cards deliver about the same performance as standard models but use half the power.

### 2. COOL DRINK

A water-alcohol blend runs through tubes that pass over the main processor and video cards. This absorbs heat better than blowing air around with noisy fans.

### 3. CENTER OF POWER

Laptop CPUs still can't compete with desktop processors, so HP uses a chip for full-size models. The Intel Core2 Q9400 contains four processors, each running at 2.7 gigahertz, effectively providing the power of two standard PCs.

### 4. LESS JUICE

Moving the power supply [not shown] outside the PC helps make the system two thirds smaller than its predecessor and allows the surrounding air—instead of fans—to cool it. Thanks to all the laptop parts, the supply draws 350 watts, versus 750 to 1,200 in other desktop gaming PCs.



**GET IT:** HP Firebird with Voodoo DNA  
From \$2,000; [hp.com](http://hp.com)

### IN RELATED NEWS: WELL-OILED MACHINE

You use oil for cooking, but how about for cooling computers? To prevent its Reactor gaming PC from overheating when running at full blast, Hardcore Computer submerges all the electronics in 4.5 gallons of a synthetic, biodegradable oil. Denser than air, the oil absorbs more than 10 times as much heat, which it vents through a radiator on the back of the PC. The fluid doesn't conduct electricity, so the system won't short out. And the coolant won't leak: The Reactor's sealed tank is made of a high-strength plastic similar to the kind used in the visors of astronauts' helmets.—SEAN PORTNOY  
From \$3,600; [hardcorecomputer.com](http://hardcorecomputer.com)



BRIAN KLUTCH



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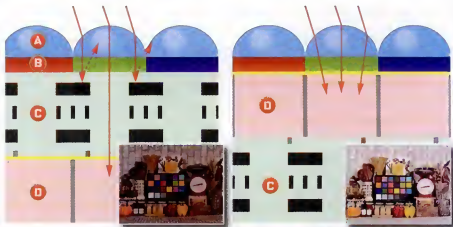
THE FIRST CAMCORDER WITH GPS DELIVERS EXTRA-BRIGHT VIDEO

Sony's **XR520V** high-def camcorder packs a lot of new tech, starting with a CMOS image sensor that captures crisp video even by candlelight. Circuitry in other sensors blocks some light from reaching the photo diodes in each pixel. Sony moved that wiring to the back of the chip to let more photons through, and it designed more-precise micro-lenses over each diode to ensure that light doesn't spill onto neighboring diodes.

In addition, the **XR520V** is the first camcorder with a GPS receiver. It records coordinates in still-picture data files, making it possible for visitors to view photos by location on Web sites such as Flickr. Because there's no standard way to do that with video, Sony tags each clip with its own data file, which the company's PC software uses to geographically organize your videos.

The camcorder also has an improved image stabilizer with a movable lens that compensates for 10 times the motion. Video we shot with a deliberately shaky hand looked as if the camera had been on a tripod. —STEVE MORGENSTERN

In a conventional camcorder sensor (below, left), light passes through micro-lenses [A] and color filters [B] and is partly blocked by a layer of circuitry [C] before it reaches the photo diodes [D] that register it. That circuitry is in the bottom of Sony's Exmor-R sensor (right), so light flows freely.



### SONY HDR-XR520V HD CAMCORDER

**Recording formats:** 1080i AVCHD video (with Dolby Digital 5.1 audio); 12-megapixel JPEG stills

**Storage:** 240-gigabyte hard drive (up to 92 hours of HD); Memory Stick PRO Duo slot

**Size:** 2.8 x 3.0 x 5.3 in.; 17 oz.

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**Get it:** [sonystyle.com](http://sonystyle.com)



ILLUSTRATION: PAUL WOOTTON; PHOTOGRAPHS: COURTESY SONY

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WHAT'S  
NEXT

# PULL OFF OR NOD OFF

NEW BENZES CAN TELL WHEN YOU'RE GETTING SLEEPY

It's late and you just want to get those last 100 miles of interstate behind you, drowsiness be damned. Bad idea. Recognizing that too many fatigued road-trippers end up in accidents, Mercedes-Benz developed software, dubbed Attention Assist, that monitors behavior and urges sleepy drivers to get some rest. The system will debut on two of the company's 2010 luxury sedans, the redesigned midsize E-Class [concept design above] and its flagship S-Class.

Sensors measure 70 types of input, including acceleration, steering and the use of turn signals. Software compares the input to data that Mercedes gathered from 550 test drivers who altogether suffered through 500,000 sleep-deprived miles. As a driver shows signs of tiredness, an icon of a coffee cup and a stern entreaty to "Pause!" appear on the speedometer. That doesn't mean grab a quad-shot of espresso and keep going. It means pull over for a nap. —MIKE SPINELLI

## ► ASLEEP AT THE WHEEL?

One sensor, accurate to 0.1 degree of rotation, measures how people turn the steering wheel. Drowsy drivers often barely touch the wheel for long periods and then abruptly yank it to correct their course.



## IN RELATED NEWS: SEE IN THE DARK

**Automotive night vision** just got clearer eyesight. BMW's Night Vision 2, available on new 7-series cars, is the first system to search the infrared images on its LCD screen for figures of people. It highlights pedestrians and cyclists in yellow and displays symbols indicating if they are likely to cross the car's path. An optional display projects alerts onto the windshield. —DAN CARNEY

COURTESY MERCEDES-BENZ



DOES IT  
WORK?

# CANCELING CABLE

TWO NEW WAYS TO SEND HD VIDEO TO YOUR TV WITHOUT WIRES

Flat-panels were supposed to eliminate the hulking television cabinet. But they are tethered to boxes—cable tuners, disc players, A/V receivers—that fill a big piece of furniture. A wireless connection lets you at least stash those peripherals out of the way. We tried out the first two cable-free HD technologies:

one that uses radio waves and another that piggybacks on your home's electrical wiring. We tested them by sending video 25 feet from both a Blu-ray disc player and a Sencore VP401, a machine that produces test patterns that break up conspicuously if there are any reception problems.—SEÁN CAPTAIN

## THROUGH THE AIR



### THE TECH

Sony's Wireless Link uses a technology called WHDI to send data over a signal similar to Wi-Fi. WHDI favors data bits with a big effect on the picture—say, ones that change the color of an object. It may sacrifice others, like bits that subtly affect hue.

### THE RESULTS

WHDI certainly loses a lot of data. We saw that clearly with

test patterns: Some finely detailed images stressed the system so severely that the screen went blank. But with a Blu-ray movie, video and audio seemed crisp and fluid. The errors in the signal were undetectable to a casual viewer.

**Sony Bravia Wireless Link \$800; sonystyle.com**

### EDITORS' RANK

⊗⊗⊗⊗⊗⊗⊗⊗⊗

## THROUGH THE WALLS



### THE TECH

HD Powerlink converts high-def video into a format called motion-JPEG and sends it over Ethernet signals through the power wires in your home's walls.

### THE RESULTS

Running over modern home wiring, test patterns looked almost perfect, but actual video had minor problems. Dark areas onscreen, such

as shadowy interiors, often appeared blocky, and colors overall were slightly faded. Both could be from errors in converting video to and from the M-JPEG format. We also heard a faint hum from the TV's speakers.

**Acoustic Research HDP100 Powerlink \$400; araccessories.com**

### EDITORS' RANK

⊗⊗⊗⊗⊗⊗⊗⊗⊗

## BREAKING NEWS: MORE WIRELESS VIDEO TECH

LG is introducing a wireless technology in its LCD televisions that promises the same quality as a wired connection. Called WirelessHD, it uses 60-gigahertz signals to send uncompressed audio and video of up to full-quality 1080p resolution

with no data loss. (Sony's product stops at 1080i and dropped a lot of bits in our tests.) One problem: 60-gigahertz signals stop dead when they hit water, the main ingredient in humans. So WirelessHD uses several antennas that

steer and bounce the signal around obstacles, even people in motion, to find a clear path. It seemed to work fine in a prototype we saw. Companies including Panasonic and Samsung are also developing WirelessHD products.

IT'S ABOUT  
TIME

## SMART TAGS

ATTACH DIGITAL INFO TO ANYTHING, FROM STUFFED ANIMALS  
TO BUSINESS CARDS, WITH DO-IT-YOURSELF RADIO CHIPS

Create a business card that automatically places a Skype call when waved near a computer, or a photo that opens an online video of your vacation. A new kit makes it easy to devise your own uses for radio-frequency ID tags, something that previously only programmers could do.

TikiTag's kit comes with an RFID reader, plus 10 stick-on chips that transmit data over short-distance radio waves, just like the chips in electronic security badges and PayPass credit cards. When scanned by the reader or a reader-equipped cellphone (such as the

Nokia 6212 Classic, below), each chip emits a unique signal. Software on a computer or phone looks up this ID in TikiTag's online database, which stores your instructions for what program to trigger next.

TikiTag can pass commands to several programs, including Skype, iTunes and Web browsers, and others are in the works. Soon a tag could connect to home-automation applications to open the door when you swipe, or act as a store's frequent-user card, updating the online database every time it's used.—LAUREN AARONSON

## IN RELATED NEWS

## PLAYING PHONE TAG

The 6212 both sends and receives radio-frequency data. It packs a near-field communication chip, which incorporates a tag and a reader for short-distance waves. Visa is running trials that use the phone in place of a credit card. **Nokia 6212 Classic** \$400; [nokia.com](http://nokia.com)



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- Heather Clancy,  
ZDNet.com

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## MEDICINE

# THE NEW VIRUS KILLER

SCIENTISTS TRY TO TURN HIV'S GREATEST STRENGTH—MUTATION—AGAINST ITSELF

At first it sounds like a terrible plan, the kind that results in zombies ruling the Earth. Imagine a killer virus, a bug that mutates so often that it inevitably finds a way to resist every drug. Now, rather than fight its ability to evolve, you enhance it. You speed up the mutation rate, forcing such dramatic genetic change that the virus crashes completely. In the movies, this technique, known as lethal mutagenesis, would create a supergerm, but in real life it's spawning a powerful new class of antiviral drugs. "It's a fundamentally different strategy," says University of Washington biologist Robert Smith. "Death by mutation."

Several university labs are investigating this tactic for combating viruses such as hepatitis C and West Nile. But the research that's furthest along, and that a few pharmaceutical companies are backing, targets HIV, a virus that is rapidly out-evolving the medications on which 33 million infected people depend. Seattle-based Koronis Pharmaceuticals is leading the way with the first HIV mutation booster to advance to human trials.

Known as KP-1461, the drug employs a counterintuitive attack. When an HIV particle invades a cell, it transforms its genetic



**DEATH BY MUTATION** Clockwise from top: A scientist isolates virus samples from an AIDS patient; a clinic in India admits 60 HIV patients a day as the worldwide total hits 33 million; KP-1461 molecules [yellow] kill a virus by disrupting DNA [blue] replication.

information into double-stranded DNA. The cell, mistaking the infected DNA for its own, replicates it and churns out more HIV particles. Most drugs disrupt this process, but HIV evolves around them. KP-1461 lets the replication run so wild that the virus self-destructs.

The trick is disguising the drug's molecules as the building blocks of HIV. When the virus replicates, it inserts the KP-1461 imposters throughout its genetic code, creating so many mistakes that it no longer has enough viable DNA to sustain its basic

## CLIMATE SCIENCE

# MEASURING THE END OF THE WORLD

EXPLORERS HIKE TO THE NORTH POLE TO FIGURE OUT HOW FAST ARCTIC ICE IS MELTING

**This month**, polar explorer Pen Hadow will embark on the most exhaustive study of Arctic ice to date. He and two companions will tug an ice-penetrating radar rig from Canada to the North Pole to deliver the best-yet estimate of how fast the ice is melting.

Nearly every satellite study indicates that the cap's days are numbered, but the data is rather suspect, says Peter Wadhams, a professor of polar ocean physics at the University of Cambridge. "From that distance, satellites can't differentiate between ice and snow." As such, projections for the first ice-free Arctic summer range from 5 to 100 years.

Over the next three months, Hadow's Catlin Arctic Survey team will take turns

hauling a radar that will measure ice thickness every foot of their treacherous 1,250-mile route (polar bears and thin ice pose considerable threats). Working in temperatures as low as -58°F, the team will also drill ice cores three times a day. "This information will enable near-real-time estimates of sea-ice conditions and make modeling much more accurate," says Wiesław Masłowski, an oceanographer at the U.S. Naval Postgraduate School. Hadow acknowledges that his efforts could turn up more bad news for the Arctic, but hopes the data will show that the ice is in better shape than experts estimate. "If not," he says, "I fear that this could be the last time this journey will be possible." —TOM CLYNES



**TEAM TALK** The three hikers will march 60 feet apart—a safety measure in case anyone falls through the ice—and stay in constant contact through Jawbone headsets and throat-located microphones. These link to transceivers on the sled, allowing real-time communication with headquarters in England.

functions, let alone take over a host cell. As a result, the virus dies.

Though promising, the basic premise has raised concerns about cultivating that Hollywood-caliber supergerm. Louis Mansky, a virologist at the University of Minnesota, says that risk is minimal. In nature, he points out, the vast majority of mutations are either harmful or neutral to organisms, and a virus must replicate 10,

20 or even 100 times for drug resistance to evolve. Crippling the bug before that stage is key, he says.

But nailing that cutoff remains a sticking point. Mansky is lab-testing a drug cocktail that kills nearly the entire population of HIV cells after just one round of replication, but human tests are a few years away. Koronis's clinical trials of KP-1461 last summer weren't as effec-

tive as lab tests. Jeff Parkins, the vice president of clinical development, says researchers are honing the dosing strategy for trials planned for later this year.

Harnessing lethal mutagenesis may soon become easier, following a new mathematical formula by bioengineer Michael Deem of Rice University that could help researchers fine-tune compounds earlier in the process. Given a few key variables,



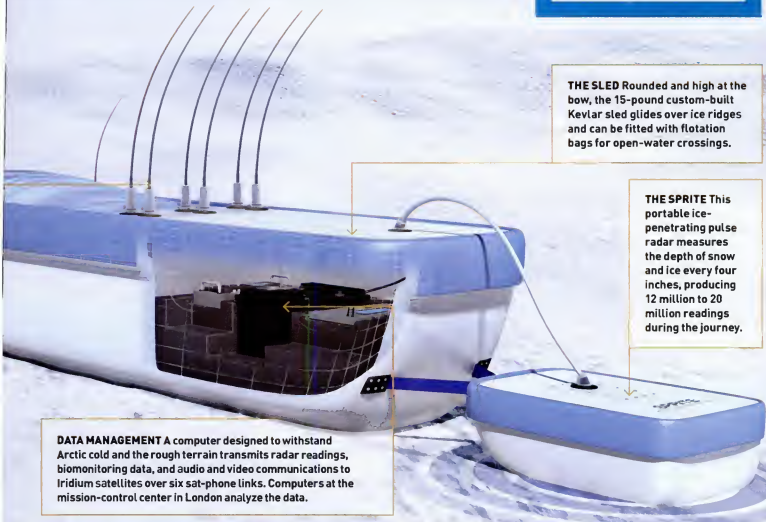
**VITAL SIGNS** The hikers will wear physiological sensors that monitor and transmit pulse, blood flow, core temperature, respiratory rate and posture to mission headquarters.



**THE ROUTE** Hadow's team will fly north from Resolute, Canada, to the point where solid ice begins. The team will cover 1,250 miles as they zigzag to compensate for drifting ice.

## FOLLOW ALONG

Chart the team's progress at the Catlin Arctic Survey Web site ([catlinarcticsurvey.com](http://catlinarcticsurvey.com)), which features webcam reports and live commentaries as well as data from the biomonitors. You can also sign up to receive text or e-mail alerts whenever team members' heart rates rise above a preselected level, indicating that a dramatic incident (polar-bear attack!) may be taking place.



**THE SLED** Rounded and high at the bow, the 15-pound custom-built Kevlar sled glides over ice ridges and can be fitted with flotation bags for open-water crossings.

**THE SPRITE** This portable ice-penetrating pulse radar measures the depth of snow and ice every four inches, producing 12 million to 20 million readings during the journey.

**DATA MANAGEMENT** A computer designed to withstand Arctic cold and the rough terrain transmits radar readings, biomonitoring data, and audio and video communications to Iridium satellites over six sat-phone links. Computers at the mission-control center in London analyze the data.

"THE VIRUS IS NOT GOING TO COME BACK AND CAUSE PROBLEMS."

such as how often viral genes shuffle inside cells, his equations can provide the minimum mutation rate to safely kill a virus. At this pace the virus won't have time to correct errors or absorb drug-evading changes, and it will crash. "It's not going to come back and cause problems," Deem assures.

Coupled with work like Deem's, lethal mutagenesis could lead to a penicillin-like drug that knocks out numerous viruses—

influenza, SARS and more. Parkins maintains hope that his company's drug could eradicate HIV, or at least offer an alternative to current treatments. And that, researchers say, is what makes the mutation tactic attractive. "Even if it just leads to a different antiviral," says virologist Satish Pillai of the University of California at San Francisco, "it would still be great for patients who have very few options left." —GREGORY MOORE

## WHAT'S THE BIG IDEA?

## MESSAGE IN A BOTTLE

EXPLORER DAVID DE ROTHSCHILD PROMOTES OCEAN CLEANUP ON A PLASTIC-BOTTLE RAFT

**Given the choice,** you probably wouldn't risk sailing 11,500 miles from San Francisco to Sydney in a boat handmade of 20,000 plastic water bottles. But David de Rothschild, the founder of the nonprofit educational organization Adventure Ecology, sees such a vessel as the perfect way to "beat waste" by promoting new uses for recycled plastic while dramatizing the problem of ocean debris. Next month, de Rothschild and a crew of scientists will sail the *Plastiki*, a 60-foot catamaran, to environmental hotspots including Bikini Atoll, the former atomic-bomb testing site, and Tuvalu, an island rapidly disappearing under rising seas. He will also swing by the northern reaches of the Great Pacific Garbage Patch, the Canada-size, 100-million-ton accumulation of mostly plastic refuse trapped in a vortex of ocean currents in the middle of the Pacific. This toxic stew, made up of everything from decomposing Lego blocks to supermarket bags, kills more than a million seabirds and 100,000 mammals a year. We talked to de Rothschild about coming face-to-face with the refuse and his plan to help clean it up. —ARNIE COOPER

**Q: How bad is plastic pollution in the oceans?**

**A:** The National Academy of Sciences estimates that five million tons of plastic enter the ocean each year. Some large pieces float on the surface; plankton and fish ingest microscopic fragments. It concentrates wherever ocean currents converge, the most notorious of which is the Great Pacific Garbage Patch, which extends from about 500 miles west of California into the Sea of Japan. There's also one off the western coast of Antarctica, and scientists have just found a huge patch off the coast of Chile.

**Q: You're planning a difficult journey—so why a boat made of plastic bottles?**

**A:** We needed a pinup to draw attention to the problem, and for me the emblem of a

cradle-to-grave society is the plastic water bottle. On average, people in the U.S. use 157 bottles of water every year. Most of that trash ends up in landfills and the ocean. We're really hoping people might say, "Hey, if you can build a boat out of recycled plastic, why not a TV?" We want to inspire industry to find more-innovative ways to reuse plastic.

**Q: How do you make 20,000 plastic bottles into a seaworthy boat?**

**A:** We originally wanted to make the

*Plastiki* entirely out of these bottles, but it kept twisting like a piece of licorice. So we built a frame by sandwiching plastic foam between "cloth" sheets made by a Danish company from recycled plastic. We injected CO<sub>2</sub> into each bottle, sealed it, and packed it into one of two pontoons. Then we strapped each pontoon to a rigid plastic tube running the length of the hull. We've assembled the whole thing without glues or resins, so when the trip is



**PLOTTING COURSE**  
De Rothschild will sail the *Plastiki* around the largest trash heap in the Pacific.



## "IF WE CAN MAKE A BOAT FROM RECYCLED PLASTIC, WHY NOT A TV?"

over in June, we'll be able to recycle the entire boat.

### **Q: Besides boats, how can we reuse plastic?**

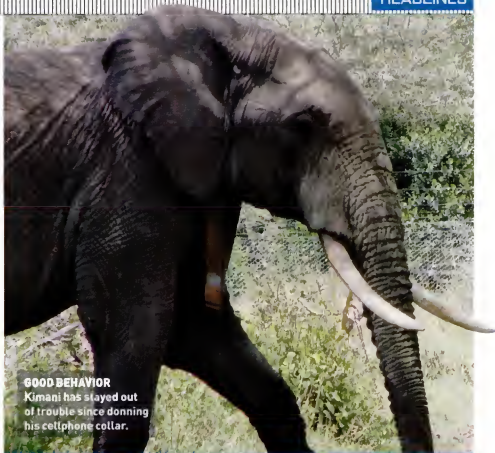
**A:** I came across two promising technologies while building my boat. There's an inventor in New Zealand who has a machine that converts various types of plastic into building bricks. There's also a Japanese company that transforms waste plastic into diesel. Tuvalu produces 450,000 pounds of plastic waste per year and imports 265,000 gallons of fuel. With a machine like this, it could cut fuel imports by 20 percent.

### **Q: How is your expedition going to help clean up the oceans?**

**A:** At Adventure Ecology, we take an issue and find a hook to inspire children and adults to get directly involved. We'll stop during our expedition to do beach cleanups and talk at schools, and post videos of our experiences on our blog, *theplastiki.com*. We're also carrying four scientists from the Scripps Research Institute who will study marine debris, ocean acidification, coral bleaching, and overfishing, and publish their findings when the voyage wraps up.

### **Q: You've said you get seasick in a bathtub. How are you psyching yourself up for an 11,500-mile ocean voyage in an unproven vessel?**

**A:** Ignorance is bliss. Of course, something sharp in the vortex could pierce the bottles and damage the pontoons. But even if we never make it past Hawaii, I feel that we'll make a huge impact by raising awareness about plastics in the ocean and using waste as a resource. ■



**GOOD BEHAVIOR**  
Kimani has stayed out of trouble since donning his cellphone collar.

### CONSERVATION TECH

## S.O.S. VIA SMS

### FARM-RAIDING, CELLPHONE-TOTING ELEPHANTS TEXT THEIR LOCATION TO PARK RANGERS

If the Kenya Wildlife Service starts running up its text-messaging charges, it has 44 elephants to blame. Rangers in Kenya have outfitted elephants with cellphone- and GPS-equipped collars that send warning messages when the pachyderms are about to raid farms.

In 2006 the rangers tested the collars on a repeat offender named Kimani, who had broken through electric fences 20 consecutive nights and caused thousands of dollars in damage to crops and farm equipment. "Most farmers have no idea that their field is being raided until the damage is done," says Jake Wall, a software programmer for the Save the Elephants Tracking Animals for Conservation program. Now Kimani's collar texts his hourly position to a server in Nairobi, where Wall's AnimalLink software compares the animal's location with a

database of virtual borders established around villages and farms. If Kimani strays across one of those borders, the system alerts researchers and rangers in the area so they can coax him away from trouble. "For every elephant we've collared, there are 20 more that also raid crops," Wall says. "We hope that curbing the behavior of the major troublemakers will rub off on the other elephants."

So far, the system has helped rangers nab Kimani and 43 recently collared elephants before they raided farms, but it was unable to protect three of the collared animals from poachers. Elephants generally sleep fewer than four hours at a time, so Wall is upgrading the software to send out a warning text if an animal hasn't moved for five hours, which could help rangers catch poachers in the act. —COREY BINNS

## MODERN CRIME-FIGHTING

## LO-JACK FOR CACTI

RADIO TAGS THWART THEFT OF ARIZONA'S ICONIC PLANT

Two thieves could face hundreds of thousands of dollars in fines and possibly years in jail after pulling off one of the highest-profile heists in Arizona history. Their loot: 17 saguaro cacti they uprooted two years ago from Saguaro National Park near Tucson. The 35- to 70-year-old plants each stand five to seven feet tall (saguaros grow to well over 40 feet, but young plants like these are easier to steal) and can fetch \$2,000 apiece from landscapers. "We have an active patrol," says the park's chief ranger, Bob Love. "But we can't be every place all the time." To stop the pillaging, Love and his team will imbed radio-frequency identification tags,

like those used to identify pets, in 1,000 cacti throughout the 91,000-acre park.

With the tags in place, rangers can scan suspicious cacti in truck beds and at nurseries to make sure they weren't pilfered. Ideally, Love says, the mere presence of the tags will deter theft. The tech will also make it easier for scientists to keep track of some of the park's 1.3 million saguaros and record their location, health and growth rate. "The saguaros are an integral part of the Sonoran Desert," Love says. "They provide habitats for a variety of animals and birds. Losing them is a serious problem."

He calculates that the tags and scanners will cost the park around \$5,000. That might sound like a bargain to city officials implementing a similar system in Palm Desert, California, where thieves have made off with 50 barrel cacti and agave plants in the past six months, a haul worth \$20,000. Love still needs to confirm that the chips won't hurt the saguaros, but he expects to begin tagging plants by the end of the year. —COREY BINNS



**SAGUARO SAVERS**  
City officials in Palm Desert have begun injecting radio-frequency ID tags into barrel cacti [above] to prevent theft. Rangers at Saguaro National Park will inject similar tags [right] into their iconic plants [left].



**VINTAGE VINO** Particle accelerators and electronic tongues ensure that your rare wine is the real thing.

## 30-SECOND SCIENCE

## FINER WINE

SPOTTING FAKE WINE WITH AN ATOM SMASHER, AND GROWING PERFECT GRAPES

## ROBOT SOMMELIER

Is your \$30,000 bottle of Chateau Petrus Bordeaux truly a rare vintage, or is it just \$30 merlot? Counterfeits plague rare-wine auctions, but researchers in Spain have built a handheld "electronic tongue" that detects them instantly. It measures the signature chemicals, acidity and sugar content in a drop of wine (typically one bottle from a case) and runs those against a database of certified vintage wines to catch fakes that might fool human tasters.

WINE = MC<sup>2</sup>

Forget finding the 11th dimension—how old is that wine? Scientists at Arcane, a nonprofit technology group in France, can confirm a wine's age using a particle accelerator. Analysis of the x-rays created as the protons hit the bottle reveals what type of furnace the glass was fired in, and thus where and when the bottle was made. The process costs \$500, so the Antique Wine Company in London, which owns the rights to the test, uses it to validate only extremely valuable bottles of 19th-century Bordeaux.

## IRRIGATION 2.0

Irrigating vines is a game of chance. Too much water drowns the grapes; too little, and they become raisins. A new system by the biotech start-up Fruition Sciences monitors water flow through plants with vine-mounted thermal sensors. A computer considers these readings, the variety's demands and climatic conditions, and determines irrigation settings so that grapes get their optimal daily water. The company, which is busy making less-expensive sensors, has rolled out the tech in California and is looking to bring the tech to France. —LISA KATAYAMA

CLOCKWISE FROM TOP: GRANT V. JAIN/GETTY IMAGES; DAVID HERMAN/CITY OF PALM DESERT; COURTESY VINCIP; GEORGE GRALLAGHY IMAGES

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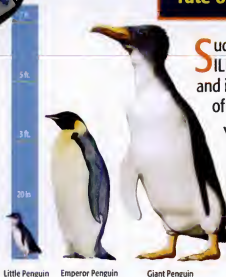


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This robotic hand uses the principle called "morphological intelligence", which processes visual sensations before impulses are relayed to the brain. Using this principle, the fingers themselves work out how to grasp an object.

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# PLANET FIXERS

CLEVER INNOVATIONS FOR A GREENER FUTURE



**GREEN STREETS** A device saves truckers fuel.

## DIESEL DIET

**California-based** Save the World Air, Inc., says its Elektra fuel pump add-on can improve a big-rig truck's highway fuel economy by as much as 10 percent. That could cull a trailer truck's diesel intake by more than 2,000 gallons a year, says Joe Dell, the company's vice president for marketing, saving a typical 1,000-truck fleet two million gallons. The thermos-size device is based on technology from Temple University that thins fuel with an electric field, creating smaller droplets that burn more thoroughly, which yields more energy and pumps less unburned fuel from the exhaust pipe. The company will test a refined, smaller version of the device this year and could have a model ready for diesel cars by 2011.

## TURNING THE TIDE

**Engineers** at the University of Oxford recently tested a 1.5-foot-wide prototype turbine that generates energy by spinning in the tide like the blades of a push lawn mower. The cylindrical turbines could be roughly 10 percent less efficient than fan-shaped turbines, but each rotor's size—the full-size versions will be 33 feet in diameter and 200 feet long—and the ability to link multiple units means they can harness more energy for less money. Spanning an entire river with the six-megawatt turbines could save 40 percent per megawatt on manufacturing and 60 percent on maintenance. The engineers are lining up funding and plan to evaluate a full-scale device next year.



**ROLL WITH IT** Several linked push-mower turbines could span a river.

**BLACK HOLE** A regular solar cell [left] reflects about one third of the light hitting it at an angle. A cell coated with antireflective film [right] absorbs 96 percent.

## A FUNNEL FOR SUNLIGHT

**Solar panels convert** the most light into electricity when the sun shines directly on them, but as soon as it wanes, so does efficiency. A new antireflective film coating could help panels collect sunshine at 96 percent efficiency from nearly any angle. Developed by scientists at Rensselaer Polytechnic Institute, the film consists of seven layers of nanoscopic silicon and titanium-oxide rods arranged in increasing densities, with the topmost nearly as porous as air. This funnel-like setup captures light from almost every direction and focuses it onto the photovoltaic panel while also inhibiting reflection. The film, which is about one hundredth as thick as a human hair, could easily be applied to any solar panel, says lead researcher Shawn-Yu Lin, and would help collect 20 percent more light while eliminating the need for the expensive hardware usually used to rotate solar panels as the sun moves. Before Lin can sell the film, he must find a way to protect the outermost layers from the wind and heat, a process that he says may take another year. —DANNY FREEDMAN



## INVENTION OF THE MONTH

# A PANIC ROOM FOR MINERS

**A NEW INFLATABLE SAFETY DEVICE COULD KEEP TRAPPED COAL MINERS ALIVE UNTIL HELP ARRIVES**

A team of coal miners is working hundreds of feet underground when an explosion rocks the tunnel. They scramble for an exit, but those are all blocked. The air fills with dust and gas. There's no escape . . . so the survivors inflate a portable panic room, complete with an oxygen supply and air filters, and wait for help. At least that's how Jim Reuther, a senior research scientist at the R&D giant Battelle, hopes the situation pans out.

After the 2006 mine explosion in Sago, West Virginia, trapped 13 coal

miners—12 of whom died—for two days, mining companies and the government reevaluated safety standards. "We realized that if miners were trapped like that again, they would need something that would help them survive for days, not hours," Reuther says.

So he and his colleagues devised the Mine Barrier Survival System, which consists of two fridge-size trunks packed with compressed plastic walls that miners can carry with them on a cart as they work. At the touch of a button, the walls



**LIFE SUPPORT** This inflatable wall could provide miners with oxygen and heat for a week.


at each end of the tunnel inflate to seal off a safe zone [see "How It Works," below]. Built-in air filters remove carbon monoxide and carbon dioxide, and the chemical reaction that inflates the walls provides enough heat and oxygen to help keep 15 miners alive for a week.

Reuther's group will refine the design over the next few months to meet the new guidelines, issued early this year by the Mine Health and Safety Administration, in hopes that their system will become the standard survival kit.—STUART FOX

## HOW IT WORKS

After an explosion or collapse, miners set up the trunks [A] at each end of the remaining open space. They then trigger a chemical reaction that ignites a solid propellant to inflate the plastic walls [B] with oxygen-rich air and form an airtight seal at both ends of the mine. The inflation reaction also generates enough heat to keep miners warm for a week. The walls keep carbon monoxide out, and scrubbers [C] remove carbon dioxide from the air inside. The scrubbers also pump oxygen into the safe space, and a computer [D] monitors pressure to keep the walls inflated enough to seal the compartment.





A BIRD? A PLANE?  
May 14, 2008: Yves  
Rossy soars skyward  
at 134 mph wearing a  
homemade jet-fueled  
wingsuit.

# WINGMAN

What kind of lunatic straps jet engines to his back and leaps out of an airplane? The kind of lunatic who may well deliver the personal flying machine of our dreams, that's what kind



**THE WARM AUTUMN SUN** has burned a hole in the morning haze and opened up the sky above the South Foreland Lighthouse, a historic beacon along the White Cliffs of Dover, England. It marks the narrowest point of the English Channel. You can't quite make out where the sea meets the coast of France, a tantalizing 22 miles distant, but a little surface gauze won't interfere with what's coming across the Channel today. In anticipation, I'm penned into a viewing platform at the base of the monument with some 100 other journalists, scanning the spotless blue for "Jet Man," a Swiss pilot and amateur aeronautical engineer named Yves Rossy who intends to show the world what it means to come as humanly close as possible to flying like a bird.

A few minutes ago, we're told, Rossy jumped out of a plane 6,600 feet above Cap Gris Nez, on the French side, unfolded the composite wing on his back to its full 8-foot-2-inch span, and hit the thrusters. Assisted by four model-size jet engines and a slight tailwind, he should be screaming

#### THREE KEY FACTS

- 1 Last September, Swiss pilot Yves Rossy became the first person to pilot a jet-propelled personal wing 22 miles across the English Channel.
- 2 Rossy's next goal is to build a wing that will let him fly straight up like a fighter jet.
- 3 After that: a consumer model for the rest of us.



**LEAP OF FAITH**  
Rossy, an unlikely adrenaline junkie at 49, leaves the jump plane. Right: The Swiss pilot on terra firma near his home north of Lake Geneva. Facing page: About to unfurl his wing above Bex, Switzerland, last May.



toward us at 134 mph, about a mile above the Channel. "It's quite exciting to have half the world's media here," says a local television reporter. She exaggerates, though it's true that this spectacle is being broadcast live to 164 countries by the National Geographic Channel.

Rossy's plan is to parachute onto a tongue of manicured turf at the cliff's edge just in front of us, thus demonstrating the reliability and future potential of his winged flying contraption. But after two days of aborted missions, and little to do in the grim port town of Dover except contemplate the worst, pessimism is starting to set in. Rossy's homemade wing is reportedly unstable, his fuel supply is largely untested at this distance, and if a flat spin or an empty tank forces him to ditch the wing, he'll plunk down in one of the busiest shipping lanes in the world, possibly tangling in his chute, possibly drowning.

"He's completely nuts, isn't he?" exclaims one reporter. "I mean, he hasn't practiced much, has he?" A photographer chips in: "As someone was saying earlier, most people who break records and keep at it, die."

The first sign of Rossy comes when several escort planes and helicopters reach the cliffs, but they're much larger craft than he is. I hear the whine of his turbines before he becomes visible.

"Oh, it's such a speck!" someone shouts.

"Do you see him?"

Then a burst of bright green and blue blossoms in the sky, and people cheer at the sight of Rossy's chute.

"This modern-day Buzz Lightyear has done it!" a baggy-suited TV reporter bleats at his camera.

Rossy's trajectory is clearly overshooting the staging area, and one by one, reporters and onlookers scramble

over fences and around barricades, at first trotting and then running through the freshly tilled field toward where he's closing in on his shadow. The Jet Man, under the weight of his wing, spraddles out on all fours in a poof of dust and straw. A line of panting security guards hold off the gathering crowd as Rossy's crew help him out of the wing, but when they lock arms around him to escort him to the lighthouse, the photographers pounce, climbing over one another like spawning salmon.

"Yves! Yves! Just here, please!" pleads one photographer.

"Go back. Go back, please. Go back," says the tallest of the guards, bulling the scrum forward. "Keep walking, please, that's it. Thank you."

"Bravo for the Jet Man!" an onlooker cheers. "Well done, well done!"

Once his handlers contain the media mob, Rossy saunters out from the lighthouse and, very casually, says, "Hello, everybody." Then he spends two hours working his way down a barricade, speaking in English, French and German. Up close, he hardly looks the part of the death-defying super-dude, just descended from the skies like some comic-book hero. He's bald with gray sidewalls befitting his 49 years, and downright scrawny. His fireproof Nomex flight suit drapes from his shoulders like a Gumby costume on a wooden hanger. Reading glasses hang around his neck, and he listens with his hands folded in front of him, studying each reporter intently with his narrow-set, clear blue eyes.

He smiles and repeats himself, because we keep asking the same questions, and his reasoned responses don't sound like the words of a wingnut. "I am just a normal man," he says, speaking in French-accented English, "who has realized his dream to fly a little bit like a bird."





# ROSSY SPEAKS PERFECTLY SERIOUSLY ABOUT STAGING A HUMAN AEROBATICS AIR SHOW.

## SOMETHING FOR EVERYONE

The Channel crossing may have seemed like the culmination of a dream, but the truth is, Rossy's vision is only beginning to unfold. He's been working on his wing for a decade, spending enough of his own money, he says, "to buy a very nice sports car every year," until the Swiss watch company Hublot signed on to sponsor him in February 2007. (Rossy refashioned himself as "Fusionman" in a nod to the company's marketing campaign.) That financial support launched him out of the garage and into a wind tunnel and allowed him to start paying real money to the loyal friends who had been helping him.

Now with momentum finally on his side, Rossy envisions a time—maybe two years from now—when he can not only launch straight up from the ground but also tame the wing enough that others can fly it too. Never mind the personal jetpack; Rossy aims to bring the personal jet wing to the masses, or at least to those with a fair amount of parachuting experience. Knowing full well that nobody else could handle his finicky prototype as it is, he and his team are developing a simpler model that should be less treacherous to maneuver—"something for everybody,"

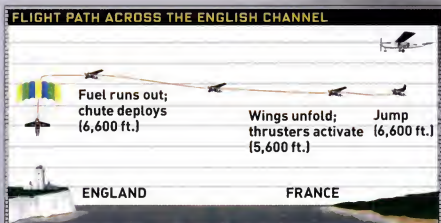
he says. Rossy speaks perfectly seriously about staging a human aerobatics air show for throngs of spectators.

But few know their way around the clouds quite like Rossy. He flew fighter jets in the Swiss army and is now an Airbus captain for Swiss International Air Lines, and he has rich experience in skydiving, parapenting, hang gliding and skysurfing. Controlling the wing requires his entire suite of skills, and it's difficult to know whether his ambition to "share the dream" with the rest of us is rooted in optimism or delusion.

Rossy is less a pilot than a birdman when he's flying the wing, which is devoid of any steering apparatus: no toggles or sticks to control the flight path. His body is the fuselage and the rudder. Arms at his side with one hand on the gas, he steers by turning his head or arching his back or dipping a foot ever so subtly. But what really sets Rossy apart from other winged stuntperformers, such as the Austrian Felix Baumgartner, who glided across the Channel in 2003 with a rigid wing (no motors), is his ability to climb and gain altitude. Baumgartner had to begin from 30,000 feet up to preserve enough altitude to reach the other side. The goal of such daredevils has always been to slow the inevitable freefall as much as possible, cheating gravity enough to

## A NEW KIND OF JETPACK

Pilot Yves Rossy has one dream, and that's to fly like a bird, or at least like a Boeing 737. The key to making it happen is this 121-pound jet-powered wing that he and his friends built from scratch. It holds 3.5 gallons of gas—enough to rocket Rossy through the air for 22 miles after he jumps from a plane at 6,600 feet. Should one of the wing's four engines fail and send him into a tailspin (a fate that has befallen Rossy dozens of times), a cutaway harness ensures him a fast getaway when he ejects the wing. A future version of the flying machine, now under construction, will probably feature a more aerodynamic delta shape, along with more-powerful engines, to facilitate Superman-style takeoffs from the ground. Birds? Who needs birds?



Cutaway harness

Jet engine sheathed in Kevlar

# "I DON'T KNOW WHERE IT COMES FROM, BUT I CANNOT STOP."

provide that *sensation* of flying. But there's a limit to how much a wing can improve glide ratio—the distance you travel horizontally versus how much you drop—unless you have four turbines churning out a combined 194 pounds of thrust mounted alongside you, like Rossy does. It's one thing to glide under a wing, slowly losing altitude; it's another, Rossy quickly discovered, to turn your face to the sun and power toward it.

His wing is a fiberglass shell wrapped around a carbon-fiber skeleton and stuffed with an electronic control unit, wires and two fiberglass tanks each holding 3.5 gallons of jet fuel. That's just enough to make the Channel crossing, at nine minutes and 32 seconds, his longest flight. (To get the extra volume, at first he tried to use the wing structure itself as a tank, but the fuel vapors ate through the foam in the shell's sandwich construction.) Fully fueled, the wing weighs 121 pounds. The turbines are modified versions of units used in model airplanes and military drones, specially

designed by the German company JetCat to ignite at high altitude and sheathed in Kevlar to protect Rossy from shrapnel should one of them explode.

Besides the engines, every bit of the wing is custom-made, the mechanical parts by Rossy and the structure by his longtime friend and collaborator Alain Ray, who owns ACT Composites in Geneva, Switzerland. The trickiest design challenge was getting the wings to fold back. Rossy wanted something with enough wingspan to improve his glide, but it needed to fit through the door of a Pilatus Porter, a common jump plane preferred by skydivers. The result was a three-section wing with a composite middle that strapped on like a backpack, and inflatable wingtips. Eventually he and Ray built a fully composite, foldable model to support the jets.

"At the beginning, I was happy without engines," Rossy says. But then he flew level with two engines. After that, he added two more and rocketed upward at nearly 45 degrees.



Fiberglass fuel tank

Composite shell

Hinged wing

"You always want more—that's human," he tells me, his voice cracking. "I would like to reach the full technical potential."

That will entail a lighter, more powerful wing that gives him the ability to swoop off the ground Superman-style and climb vertically. To hear Rossy, building it sounds entirely doable, a simple matter of going step by step. But he may have a hard time recruiting fellow birdmen who are both qualified and willing to make the leap. Bruno Brokken, for one, a skydiver of 28 years and a professional photographer who has worked with Rossy since the beginning, says no thanks. "Not with the jets burning just a few inches from your legs," Brokken says, laughing. "I've seen too many test flights where he was spinning on his back and I wasn't sure he could get out of it. I would rather take pictures."

## DYING FOR MORE

Rossy lives north of Geneva in Nyon, within view of Lake Geneva, in a scruffy two-story stucco with Majorelle-blue shutters, no curtains and, on the day I visit, dandelions sprouting from the lawn. Inside, a stuffed eagle with spread wings perched on a speaker surveys the barren living room. His parachute, the same one that drew cheers when it opened above Dover a few days ago, lies strewn across the parquet floor. Among the sparse furniture, a painted pine bookshelf contains volumes on flying, mountaineering,

philosophy and marriage counseling. *Exit*, a book of Brokken's skydiving photos, is inscribed *Merci, Yves, pour tous ces moments forts*: Thanks for all those inspiring moments. The decor suggests that this is the home of a man otherwise occupied—and, as I would discover, it seems he has always been.

Rossy earned his pilot's license before his driver's license, and by the time he joined the Swiss Army flight school for his obligatory military training, he had 34 hours under his belt. He wasn't the top pilot, but he proved his all-around excellence with the highest score in a test that included flying, shooting and physical drills and received a placard that he keeps with his first airline ticket. It reads *Pret au Vol*: Ready to Fly.

He's been airborne ever since. Rossy has flown Northrop F-5 Tiger IIs and Hawker Hunters and logged more than 1,000 hours in the Dassault Mirage III. He's flown commercial jets for 20 years and completed at least 1,400 skydiving jumps. In 1992 he took up skysurfing—freestyle snowboarding in the air—placing second in his division at the

inaugural skysurfing world championships the following year. That's when he met one of the sport's icons, the Frenchman Patrick de Gayardon, who was experimenting with a winged skydiving suit introduced in the 1930s. De Gayardon's design featured a double layer of nylon webbing between the arms and legs that stretched open like bat wings and filled with air like modern parachutes, allowing him to soar longer and farther than his predecessors. Rossy was inspired by the innovation but had his own ideas about how to stall freefall, and he designed a five-foot-wide board to surf on, something de Gayardon and others said was dangerous. In 1998 de Gayardon died while testing his wingsuit in Hawaii. Not two weeks later, Rossy dared to fly a prototype of his board for the first time.

The rig worked fine until he pulled the ripcord. Underpressure sucked his drag chute beneath the board about 5,000 feet up, preventing it from deploying the main chute. He reached back to unfurl it by hand, but the lines got tangled and his efforts to sort them out proved hopeless. Whirling like a tetherball in a sickening centrifuge, he ditched the board and cut away his main chute. Then he was freefalling again. He popped his reserve chute at 1,900 feet, about 12 seconds before impact. Maybe de Gayardon was right: Surfing a huge plank was

## MORE LEG ROOM

May 19, 2008

[right]: Rossy flies above the southern Swiss Alps, hitting the throttle to gain altitude. September 26, 2008 [facing page]: touching down in Dover after flying across the English Channel.



"YOU ALWAYS WANT MORE. THAT'S HUMAN. I WOULD LIKE TO REACH THE FULL TECHNICAL POTENTIAL."

too dangerous. But somehow the close call only galvanized him to find another approach. To Rossy it wasn't an omen; it was a challenge. "I don't know where it comes from, but I cannot stop," he says.

He considered picking up where de Gayardon left off with wingsuit technology, but he thought he could do better. If he wanted to fly, he'd need real wings. Not the flimsy bat flaps that stretched from de Gayardon's torso to his arms, but a solid structure that spanned out like the wings of an airplane. His first prototype, which he crafted from plywood and Styrofoam, extended his freefall by half a minute—enough to start him on a furious decade of designing, building, testing, breaking, and over again.

The truly crazy part? Through all the testing, he's never been injured. Like any good pilot, Rossy is meticulous about safety. His first order of business was to build a cutaway harness that would make it easy to eject the wing, which he made out of seatbelts. Now his harness is a custom-molded, stiff plastic back brace that wraps around his ribs. Rossy designed it so that he can pull a cord to release the wing, which in turn automatically shuts down the jets and deploys a parachute. At least 20 times he's gone into an uncontrollable spin and had to jettison the wing, hoping that its chute delivers his dream machine safely to the ground. He says he always has a plan B, and his best safety provision

is altitude: He wears a helmet with an audible altimeter and knows that he has to open his chute by 2,600 feet.

Although Rossy has been spared physically, his quest has wrought other damage. He's nearly lost his airline job, and did lose his marriage. "I was always thinking about my wing, aggressive when it didn't work the way I wanted it to work, and she suffered for that," Rossy says of his ex-wife. "To have all the ideas, from the concepts to the drawings to the flying, it's the most gratifying thing I've done. It's what I really profoundly want, and I had to ask this question during my divorce."

## BREAKING AWAY FROM THE FLOCK

How can an ordinary person understand such obsession? Is it really just a feeling? I'm not about to strap on Rossy's wing to find out, but I want to taste the sensation that apparently is driving him. What, exactly, is he trying to share with the rest of us? I figured jumping out of a plane was a good place to start. So one day last September, I visited the aerodrome Yverdon, not far from Lake Neuchâtel. The runway is lined with poplars, and the members of the Para Club Valais were tending to their chutes, sprawling on colorful tarps nested on the lawn like birds in an Escher drawing.

Rossy pulled off some of his first jumps with the wing





here. "We've followed his adventure from the beginning," says Christian Landry, a soft-spoken tandem instructor, squinting into the afternoon sun. "With that type of guy, things become possible. I don't know exactly in the future if he can bring something important for everybody with the technology, but only with people who live more than 100 percent can society go forward. In French we say, *metro, boulot, dodo*: subway, work, sleep. If all people are like this, we are like sheep and nothing comes better. And we need some people like Yves."

Landry wears a Tintin T-shirt over a soft belly and has something of an aerodynamic face, with a pointy nose, shaved head and swept-back chin. He has the placid smile of someone who has made more than 5,000 jumps, and I'm disappointed to learn that he won't be the one taking me up today. I realize it's almost 5 p.m., and I start to wonder if it's even going to happen—or if I want it to.

Then I'm shown a short video in French, climb into a jumpsuit, and make one last call home. I'm catching the last flight of the day on the last day of the season. A tall instructor snugs me into a harness and hands me off to another instructor who has just floated down. "My English is not very good, but it's OK," Dan assures me. He clips me to his chest, we waddle to the plane, and before I know it I'm squeezed onto his lap in the same kind of box-hulled

Pilatus Porter that Rossy leaps from, huddled beside seven other skydivers, all young and experienced. As the plane spirals up, instead of slapping high-fives, they hunch forward conspiratorially and touch two fingers with one another. And then one of them jumps up, spins around, and flings open the door.

Cold wind and the roar of the propeller rush in, and the conspirators file out in ones and twos and threes, whooping as they take to the open air. Dan scooches us to the edge, where I gain a very realistic view of the patchwork of farmland below, dangling my legs out below the step. I'm uncomfortable. I feel like I'm slouching off the edge of a couch, except there's nothing below me for a mile or so. Then, suddenly, we're out. My breath is nowhere, and Dan cups his hand around my chin to wrench my head back into the proper position—arched spine, bent knees, arms out in front. It's exactly the opposite of the fetal position, my instinctive posture. But then I breathe and look, and see the retreating sun glittering on the lake, the geometry of the cornfields and the velvety folds of

the Jura Mountains. I have no sensation that Dan is behind me, and if I didn't know better, I might think I was flying.

Dan pops our chute, we float down toward the poplars, and he brings us in for a whisper-soft landing on a cool patch of grass. An adrenaline-addled jumper named Stéphane Marmier, one of Rossy's regular crew whom I'd met in Dover, bounds over with a big smile on his face, apparently mirroring my own. "Now do you understand?"

Yes. As soon as I land, I want to do it again.

## NOWHERE TO GO BUT UP

Yet there is a huge gulf between skydiving and jumping out of a plane with a glued-together chunk of pretty-sure-it's-going-to-work on your back, just as there's a difference between gliding and flying. "It's still a prototype, and it's not 100 percent reliable, eh?" Rossy says. "There is tension every time." And no moment is tenser than when Rossy is leaping from the plane. Once his crew has fired up the four turbines, he pokes one end of the wing out and staggers his feet on the step. He rocks several times like a downhill skier in the gatehouse and then falls away to the side, holding one hand up to counteract the pull on the protruding wing. He has to get himself arranged head-down before triggering the gas shocks to snap open the ends of the wing, and as he's searching for speed he gradually


(CONTINUED ON PAGE 76)

# The Worst Jobs in Science



BY JASON DALEY  
ILLUSTRATIONS BY TRIP PARK



An illustration featuring a large, blue shark with a white underbelly and sharp teeth, looking down at a small, orange and black striped tiger sitting in front of it. A dark bird with a yellow beak is perched on the shark's head. The background is a light blue gradient.

It might seem sad, after years of study, to wind up gathering sewer rats or burning great, stinking heaps of urine samples and bloody gauze. But that's the path some professionals choose—and you're lucky they did

## Triage Biologist

**IF GLOBAL-WARMING** predictions are right, as many as a quarter of mammals now alive could be extinct in our lifetime; in other groups of plants and animals, casualties could be as high as 40 percent. Considering that humankind doesn't have the money or know-how to save them all, some scientists are calling for ecological triage—choosing which critters to preserve and which to abandon. It's a concept that came to Stanford University biologist Terry Root, who has worked on the Intergovernmental Panel on Climate Change, after witnessing her husband's cancer treatment. "I realized I'm an oncologist for the world. I realized that for some species, it's already too late," she told a conference last year. "And then there are species who, like my husband, we can work to save. And part of what we have to do is this horribly, horribly difficult process of figuring out what we can save." Researchers are already devising intelligent ways to make Terry's choice. Marc Cadotte and a group at the University of California at Santa Barbara recently published a paper assessing which flowering plants in grasslands make it over the species-saving bar.

Their general conclusion is that it behooves us to save the most genetically unique species and the ones that preserve functional ecosystems, which are often one and the same. Eventually, every species will have to be judged.

Pity the poor scientists who have to spend their days crossing cute, fuzzy things off the list.



## Monkey-Sex Observer

**THE HOT TICKET** for biologists these days? Watching monkeys do it. Every batch of new published studies seems to include simian sex. Consider Dana Pfefferle, a researcher at the German Primate Center in Göttingen, who spent two years counting monkey thrusts at Gibraltar's Upper Rock Nature Reserve to find that when the female screamed during mating, the male partner climaxed 59 percent of the time. Or Paul Vasey of the University of Lethbridge in Alberta, who has discovered that female Japanese macaques are often bisexual and will choose a female partner over a male more than 92 percent of the time. Monkey mating is everywhere. Vasey says primate prurience is essential to hu-

man sexuality research. "There are very few situations in which you can watch humans have sex," he explains, noting that monkey sex has also shed light on several other species. To eavesdrop on the macaques, Vasey travels to the outskirts of Kyoto, Japan, in the fall and winter. For up to three months, six days a week, he hikes up a small mountain to the monkey's habitat and records who mounts whom and for how long, what positions they use and what pelvic movements are employed, which he tracks using a notation system designed to record the movements of dancers. He's not at all inhibited about discussing his research with the public. After all, he says, "people like monkeys, and people like sex."

## Theoretical Physicist

**FOR MUCH OF** the past century, physics was an exciting, wide-ranging exploration. But to be a theoretical physicist today, you pretty much have to stake your career on one incredibly popular but pretty much unprovable notion: string theory. Since the idea that the universe is composed of small vibrating "strings" gained a following in the 1970s, the theory, which in some forms posits 10 dimensions and seeks a unifying "supersymmetry," has captured the theoretical-physics community in the U.S. The easiest way to earn an appointment is to dive head-first into a branch of string theory, which dominates the top programs at Princeton, MIT and other influential institutions. The problem is, we simply have no idea if we're on the right track, because the theory still isn't verifiable.

Lee Smolin, a physicist at the Perimeter Institute for Theoretical Physics in Waterloo, Canada, who investigates quantum gravity and string theory, believes that this physics monoculture is stifling. "Science has become too risk-averse, and its progress is being hurt as a result," he says. When CERN's Large Hadron Collider restarts later this year, however, it could end the waiting, helping to confirm parts of string theory—or dash it altogether. If supersymmetric particles called sparticles are bashed into existence: yay! But if the W boson particle does not react as hoped, that damages a central pillar of the theory. Across the U.S., whole careers are boiling down to the chance that a big box comes up with something.







## Vermin Handler

**SPENDING ONE'S CHILHOODOO** catching rats doesn't (necessarily) make you a psycho; at his father's hobby farm in rural Arkansas, it prepared William Parker for cutting-edge medical research. To capture them, "you have to know how rats think," he says. The Duke University professor of surgical sciences, who in 2007 helped suss out why humans have an appendix (it protects beneficial bacteria), now fishes the wriggly vermin out of traps in and around Durham, North Carolina, for an ongoing study on hygiene. He's testing the long-standing idea that mammals (including people) raised in clean, urban environments do not build as many immunities as those raised on farms or closer to natural settings. "Inner-city kids may live in a dirty environment, but it's a different kind of dirt than someone who brings goats into their house," he explains. For his work, he locates a likely rat-infested area and notes the nasty diet of the local

*Rattus norvegicus* population. After putting out unarmed live traps for several days to let his squeaky prey get acclimated, he sets the triggers, collects his test subjects, and euthanizes them with carbon dioxide. He then compares immune reactions in spleen cells from the wild, disease-prone rats with those from sterile, pickier lab rats ("They won't even touch jelly doughnuts," he says) to test the hygiene hypothesis. But Parker isn't satisfied with rodents from dumpsters and alleys. If funding comes through for the next step in his study, he plans on building a small barn full of wild house mice so he can more finely control their filthiness.

**"YOU HAVE TO KNOW  
HOW RATS THINK."**



## Hurricane Hunter

**IF YOU FREAK OUT** when turbulence threatens to topple your ginger ale, you probably won't get into the U.S. Air Force Reserve's 53rd Weather Reconnaissance Squadron. Based at

Keesler Air Force Base in Biloxi, Mississippi, the 20 pilots and their crews fly into the eyes of dangerous hurricanes, usually four times on missions of up to 12 hours. Think of it: After making it through, they circle around to do it again. (The first flight was in 1943, when an Air Force colonel pierced a Texas hurricane just to show British trainees that he could.) Why risk

it when satellites and radar do a bang-up job of tracking storms? Because it's hard to gauge the strength and growth of a hurricane without measuring the pressure in its eye, and although radar can map the center of a storm to within 60 miles, being inside it brings accuracy to within two. Missions are round-the-clock when a storm is on, and the goal is to parachute two-foot-long instruments called dropsondes through the storm to measure barometric pressure, wind speed, and so on. Inside the storm, usually at an altitude of nearly 10,000 feet, the plane can freefall 1,000 feet.

The Squadron has a plethora of applicants, says Major Chad Gibson, and no deaths in 35 years. Nevertheless, it's a maniac's job. Since the 1960s, four flights—36 people—have been lost. One plane returned so damaged that it was sent directly to the scrap heap.



## Lone Fossil Ranger

**IMAGINE A VAST BEACH** studded with pearls guarded by a sole protector, and you get a sense of paleontologist Barbara Beasley's hopeless task. Based in the Nebraska National Forest, she is charged with protecting the more than five million acres of public land in the Northern Great Plains from fossil poachers. As the only such paleontologist on staff (or on the federal payroll, for that matter), her job is to

investigate sites that have been vandalized, estimate the damage done, and help law enforcement catch thieves of the park's cache of bones. She's just plain outgunned. Of more than a dozen poaching cases she investigates every year, only one or two make it to court, and that's if the poacher is caught red-handed. Fat chance. "All that's usually left is a hole in

the ground," Beasley says. Some poachers, who net anywhere from a few hundred dollars for a set of teeth to tens of thousands for rare skulls, are bold enough to rent summer houses near fossil grounds to spend the warm season prospecting. Sometimes they plunder academic dig sites sponsored by real paleontologists. Beasley recalls a site in the Buffalo Gap National Grassland where poachers stole the skeleton of a mosasaur, the *T. rex* of the sea, failing to realize that there was an intact fossil of a baby mosasaur right next to it. "Poachers don't pay attention to context," she says. "They usually go for the sexy fossils, like skulls with teeth."

Beasley is a realist—because of lack of evidence, most poaching investigations aren't pursued and are usually just recorded as theft of public property—but hopes she can help slow the leak of fossils by educating the public in the Great Plains to report incidents as they happen. "At times, sure, it's frustrating," she admits. "If it's worth money, someone's taking it."

## Medical-Waste Burner

**EVER WONDER WHERE** your tonsils and gallbladder go once the anesthesia wears off? If your doctors are following the law, those go out the door as medical waste. At BioMedical Waste Solutions, based in Port Arthur, Texas, a fleet of leakproof trucks brings tons of trash each day to its processing facility, where a technician wearing gloves, goggles and a protective suit pulls the bags of waste from the tubs and loads them into a plastic-lined stainless-steel hopper, which is wheeled into a 6-by-13-foot autoclave. The operator vacuums the air out of the chamber before injecting it with 45 psi of 300°F steam, cooking and sterilizing the syringes, bloody gauze, and bottles of semen and urine for 40 minutes. (Limbs and chemo supplies go to specialty incinerators.) The aroma is what gets to you. "When it comes out the other end, it smells like dog food mixed with burning plastic," says Wes Sonnier, who began the company in 2005 and now processes 12 tons of waste a day. The steaming glop, which is full of melted rubber gloves, bandages and syringes, is then machine-compacted before being dropped off at the municipal dump.

Although the U.S. has medical-waste disposal down to a fine, smelly science, the rest of the world hasn't quite caught up, and teaching other countries to do it right is going to be awful work. In 2007, investigators in South Africa found an incinerator warehouse where workers were inexplicably storing rotting human limbs, used HIV test kits and petri dishes from 200 hospitals. It was thought to be one of 12 similar sites around the country.

"IT SMELLS LIKE  
DOG FOOD AND  
HOT PLASTIC."



# Leech Researcher

**FOR MARK SIDDALL** and his colleagues from the leech lab at the American Museum of Natural History in New York, the primary tool for field research is a revealing pair of shorts. "Fieldwork involves wading through swamps, allowing leeches to crawl onto us," explains Siddall, the museum's curator of invertebrates, whose subjects are increasingly being used in reconstructive surgery and in the development of anticoagulants. In the past decade, Siddall has led leech walks everywhere from Argentina to Thailand. In Madagascar during the rainy season, he says, the forest floor comes alive. "You can collect hundreds on your body just over one walk." To remove a sucker, he simply peels off the edge with his fingernail, since burned leeches tend to regurgitate into the wound. Why, God, why? Siddall has discovered or studied dozens of new species, including a leech that prefers frogs and one that likes hippo anus. And the danger? "So far, no leech-borne diseases have been identified," he says. "And to the best of my knowledge, nobody has ever been exsanguinated"—which is to say, *entirely drained of blood*.



"YOU CAN COLLECT HUNDREDS ON YOUR BODY."

## Experimental Taphonomist

**DYING IS EASY.** The study of how an animal wandering the tundra becomes a fossil underground: *That's* hard. To familiarize themselves with the mechanics of death and decay, taphonomists study the disintegration of worms, elephants and even humans. Travis Rayne Pickering, a taphonomist and paleoanthropologist at the University of Wisconsin, concentrates on big cat kills in Africa. The idea is to create a reference to help figure out whether fossil animals were killed by early humans—a sign of our sophistication—or by predators like big cats.

Pickering and his team scour the countryside for the remains of a kill to assess the aftermath and flay the carcass. "Sometimes the flesh is loose

enough to get your fingers in there and pull it off. But it usually takes quite a bit of boiling to get the skin off the head, and there's brain tissue to get out as well," says Pickering, who has had to fend off scavenging animals from his butchering camp. During other projects, he uses flint chips and rocks based on prehistoric tools to determine what kind of markings early humans made while butchering meat. Getting arm-deep in gazelle guts has helped reveal evidence of cannibalism, for instance, on a two-million-year-old human fossil. "It's the type of damage you get when removing the mandible to get meat off the face and the tongue. Without taphonomic research, we wouldn't be able to interpret those results."







## Mars Simulator Crew

**THERE ARE PLENTY** of technical problems on the way to Mars: how to avoid excess radiation, maintain food supplies, and generally not die. But the real hazard between here and there is going nuts. That's why this spring, six participants in the European Space Agency and Russia's Institute for Biomedical Problems's Mars500 program are going to lock themselves in a series of metal tubes in a facility in Moscow for 520 days, roughly the time it should take to travel 100 million miles to Mars, spend 30 days there, and return. *Bozhe moy*, that's a long time without a shower or a window.

Psychologists and biologists will be observing the effects of cramped quarters and social isolation on the four Russians and two others chosen from an applicant pool of 5,000 pilots and scientists from 45 countries. The winners

(who aren't earning a spot on any real Mars mission, by the way) will drink reprocessed urine and eat freeze-dried food, home-baked bread and whatever grows in the greenhouse. Any breakdowns, engineering or otherwise, must be remedied by the cozy crew, who will be constantly recorded by 18 cameras. Communication with mission control is delayed by 40 minutes. The reward: After 250 days, three lucky Marstronauts will be allowed to leave their 2,100-square-foot capsule, in spacesuits, to giddily explore some other unit dolled up to look like Mars for a month, before crawling back inside for the final 240 days. Have we mentioned how flippin' long that is? A similar experiment by the Institute for Biomedical Problems in 1999 ended in a bloody nose, sexual harassment and a deserter—after only 110 days.

# ICE SCOUT

A LEGENDARY SPORTS-CAR BUILDER ENGINEERS A FEATHERWEIGHT, ETHANOL-POWERED SUPERCAR ON SKIS TO LEAD AN EXPEDITION ACROSS ANTARCTICA

BY MICHAEL DUMIAK ILLUSTRATION BY PETER BOLLINGER

When you're driving a 4.7-ton truck filled with scientific equipment across a crevasse-strewn Antarctic wasteland, choosing the right path is critical. Deep cracks in the ice, invisible from a distance, can swallow a truck whole. An Antarctic expedition needs an ultra-light scout vehicle to run ahead and find a safe route before the heavy machinery rolls through. That's exactly what the Concept Ice Vehicle (CIV) is built to do.

It's the creation of England's Lotus Engineering, an arm of the custom automaker famous for building lightweight, go-kart-height sports cars like the Esprit and Elise. The CIV will lead this fall's Moon Regan TransAntarctic Expedition, a 3,000-mile trek whose goal is to gather information about snowfall patterns, the Antarctic atmosphere, and the performance of biofuels in one of the world's harshest environments.

Made of 80 percent aircraft-grade aluminum, the sled weighs only 793 pounds, light enough that its crew can drag it across the snow if the terrain gets too rough. The vehicle glides on three Teflon-coated skis, each mounted independently to shocks that can flex more than two feet in case of a particularly brutal bump. "You ride along the snow, and it can be very flat," says Kieron Bradley, the former Formula One engineer

who led the CIV team. "All of a sudden, it's four-foot sastrugi"—irregular snow ridges, cut by the wind, that would sink a regular snowmobile. Once out in front of the pack, the CIV will use ice-penetrating radar to detect crevasses and other hazards in order to map out a route for two six-wheel trucks carrying the rest of the crew and equipment.

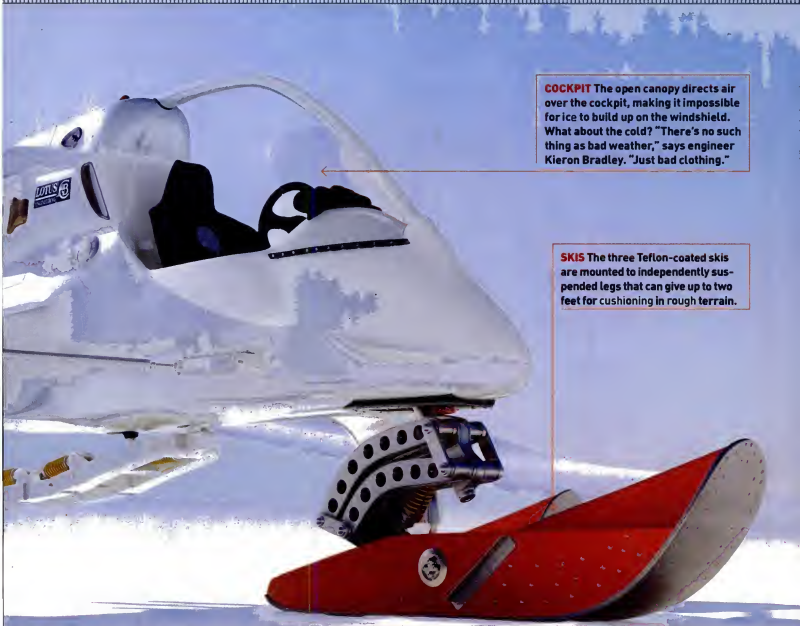
The CIV's engine, a 1.15-liter twin-stroke BMW motorcycle engine modified to use E85 fuel (85 percent ethanol), is itself a bit of an experiment: Part of the

expedition's goal is to measure the viscosity and combustion point of ethanol in a variety of altitudes and extremely cold temperatures. The 120-horsepower engine drives a rear-mounted, carbon-fiber propeller capable of pushing the CIV to 85 mph—faster than any smart operator will drive it in a low-contrast, snow-blinded environment like the Antarctic, where the driver will need plenty of time to react to any surprises.

The CIV will begin testing next month at Lotus's proving grounds in



**ENGINE** The modified 120hp, two-cylinder BMW motorcycle engine is expected to get approximately 40 miles per gallon running on E85 (85 percent ethanol, 15 percent gasoline).



**COCKPIT** The open canopy directs air over the cockpit, making it impossible for ice to build up on the windshield. What about the cold? "There's no such thing as bad weather," says engineer Kieron Bradley. "Just bad clothing."

**SKIS** The three Teflon-coated skis are mounted to independently suspended legs that can give up to two feet for cushioning in rough terrain.

Sweden, and if all goes well, in November it will lead the English adventurers Andrew Regan, Andrew Moon and Jason de Carteret on a full traverse of Antarctica, from the western Ronne ice shelf, across the South Pole, and then north through the Trans-Antarctic Mountain range to McMurdo Bay. After that journey, the CIV will have done its duty. "It's made with one purpose only," Bradley says—to finish the expedition successfully. "What they do with it afterward? It's entirely up to them."

**FIELD WORK** Lotus engineers tested the CIV last winter in Sweden.







# COLD RELIEF

TWO PHILADELPHIA DOCTORS ARE CHAMPIONING AN UNCONVENTIONAL NEW TREATMENT FOR KEEPING CARDIAC-ARREST VICTIMS ALIVE, WITH AS LITTLE BRAIN DAMAGE AS POSSIBLE: JUST GIVE THEM HYPOTHERMIA

BY MELINDA WENNER PHOTOGRAPHS BY JOHN B. CARNETT

**AT 3 P.M.** last June 22, Pam Barco's heart stopped. The 46-year-old ER clerk at the Children's Hospital of Philadelphia was near the end of her shift when she felt dizzy, put her head down on her desk, and suddenly stopped breathing. A nearby co-worker saw Barco slump over and shouted, "Staff emergency!" Minutes later, a dozen doctors and nurses surrounded Barco's body. They shocked her with a defibrillator. No response. They shocked her twice more. Nothing. Then: Beep. Beep. Beep.

On TV, this is when everyone breathes a sigh of relief. In real life, though, 9 out of 10 cardiac-arrest patients whose hearts are restarted end up dying in the hospital; of the survivors, one out of eight suffers permanent brain damage. Every minute that the heart isn't pumping starves the brain and other organs of oxygen, depriving their cells of energy.

Although Barco's heart was beating, her blood pressure was dangerously low, and she wasn't getting enough oxygen. Doctors inserted a breathing tube. When she was stable enough to be moved, they wheeled her next door to the University of Pennsylvania hospital and up to the cardiac-care unit on the eighth floor.

Nurse Jamie Weller had everything set

up. First she gave Barco a sedative to knock her out, and then another drug that paralyzed her so she wouldn't shiver. She hooked Barco's IV up to a bag of 35°–40°F saline and wrapped her legs and torso in what looked like bubble wrap with cold water flowing through it. By the morning, Barco's body temperature was 91°, cold enough that she officially had hypothermia, just as the doctors intended. She stayed like that for 24 hours.

Barco was lucky. She happened to collapse next door to the Penn Center for Resuscitation Science, where doctors Lance Becker and Benjamin Abella are convinced that a procedure that sounds like torture would in fact increase Barco's chances of surviving, while minimizing brain damage. The treatment is called therapeutic hypothermia, and it's based on the idea that what damages tissue in the heart and brain isn't the heart stopping, but rather its sudden restarting and the destructive natural reactions that occur when the oxygen comes back—unless the body is cold enough to slow the process. Two clinical trials in 2002 showed that cooling resuscitated patients within four hours of defibrilla-

tion increased their survival rate by 20 percent, even if they had been clinically dead for as long as an hour. A more recent study at the University of Pittsburgh School of Medicine, which has been using the technique for five years, showed that among certain groups, cooling doubled the number of survivors.

Yet many people have never heard of therapeutic hypothermia, and few doctors are using it. For all its promise, inducing controlled hypothermia is a complex procedure that requires doctors to develop and learn a protocol, buy special equipment, and train staff from multiple departments—all for something that sounds entirely counterintuitive. It's also a procedure that punishes imprecision: Cool a patient a few degrees too far, and you could stop her heart again.

But the U. Penn doctors who are the treatment's biggest proponents say that not only should the procedure be standard, but that doctors should go even further. They're running studies on mice and pigs that suggest that it's better to start cooling before restart-

ing the heart. Soon they will start testing this idea on humans with a machine that would let emergency-medical technicians run a "frozen slushee" IV into patients. In Becker and Abella's ideal world, at least 15 percent of the 166,000 people who have a cardiac arrest outside the hospital every year will be frozen and paralyzed before they even reach the ER.

## WHY COLD WORKS

Becker, the director of the Penn Center for Resuscitation Science, seems like a friendlier version of TV's Gregory House—a detective in a white coat and scrubs. As a medical resident in Chicago in the early 1980s, he found himself attracted to the ER (to the "really, really sick patients," he says) because he found the task of deducing what was wrong with them more interesting than the treatment.

After spending his early career at Michael Reese Hospital in Chicago, Becker started questioning the published statistics about cardiac arrest. (A heart attack is what happens when blood flow to the heart is restricted; cardiac arrest means the heart has suddenly just stopped. The latter is much rarer.) He had read that 18 percent of patients survive, but, he says, "I knew after working in the emergency department for a while that [that figure] wasn't anything close to reality." So in 1989 he analyzed data from hospital and paramedic reports for more than 3,000 local cases. He found that the rates were off by a factor of 10—only 1.8 percent of cardiac-arrest victims in Chicago lived. (The earlier studies were performed in small cities, where patients were typically reached more quickly and were more likely to receive CPR from a bystander.) Three years later, a study in New York City came up with a similar number: 1.4 percent.

But why were people dying even after their hearts had restarted? The question nagged at Becker as he began his assistant professorship at the University of Chicago Hospital in the early 1990s. Scientists believed that when the heart stopped pumping oxygen-rich blood, cells started to die. If that were true, then cells should fare better when the heart starts pumping again. "What we saw was almost the opposite," he says. Becker

watched heart cells under a microscope as he deprived them of oxygen for an hour. Then he gave them oxygen, or "reperfused" them, for another three hours. Only 4 percent of the cells showed damage initially, but 73 percent showed signs of injury immediately *after* the oxygen came back. He realized that there was something destructive about the sudden recirculation of oxygen.

Two more years of experiments revealed one of the key mechanisms. Tiny organelles called mitochondria use oxygen to produce energy, and they do so very carefully—add or subtract an electron from an oxygen atom at the wrong time, and it becomes a free radical, an ion powerful enough to damage cell structures and mutate DNA. Cells have systems in place to prevent these dangerous chain reactions, and to maintain other delicate ion balances, but without oxygen those systems break down. When oxygen flow returns, the mitochondria start producing hordes of free radicals; other cellular ion levels also go awry. The injured cells start dying, and in response, the immune system releases chemicals that worsen the effect. The problem is most pronounced in the heart and the brain, which use more oxygen than other organs.

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Around the same time, Becker made another surprising observation. As all scientists do, he kept his cells in incubators at 98.6°. But when he left them out for a few hours and they cooled a bit, "we found that there were differences in rates of cell death," he says, because the mitochondria and the immune system aren't as active at low temperatures.

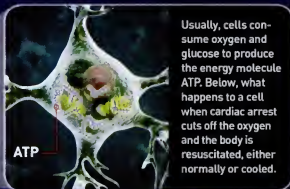
Although doctors had theorized as far back as the 1950s that cooling patients after cardiac arrest could help them survive, Becker's reperfusion research was one of the first good explanations of why it worked at the cellular level. "But we had to ask ourselves this very difficult question," he says. "Did what we were seeing in cells translate to people?" So after publishing his findings, he began experimenting on mice and, by 1999, pigs. All the results were consistent with what he'd seen in cells, and with what other researchers were finding. In 2002, doctors in Europe and Australia published the first human studies, showing that the treatment saved one out of every five patients who would have otherwise died. By 2003, Becker was using the treatment on his own patients in Chicago. In 2005 he and Abella even helped convince the American Heart Association to endorse hypothermia in its recommended guidelines. Today, ambulances in New York, Miami, Boston and Seattle will take cardiac-arrest victims only to hospitals that have cooling protocols. Freezing your patients has gained official acceptance.

## THE TROUBLE WITH HYPOTHERMIA

But if the AHA endorsement represented a mainstreaming of the treatment, it didn't result in widespread use, especially outside those urban areas. According to a 2006 survey by Abella, just 26 percent of U.S. emergency-room and cardiology doctors had ever cooled a patient after cardiac arrest. The guidelines advise doctors to use cooling, but they don't go into detail about how best to do it. In addition,

## HOW A COLD HEART CAN SAVE YOUR BRAIN

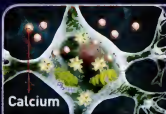
In **therapeutic hypothermia**, doctors intentionally cool cardiac-arrest patients to 91°. The idea is to slow the cellular reactions that can cause brain and other organ damage after the heart restarts. The physician Lance Becker found that giving oxygen to cells that had been starved while the heart was stopped causes the cell to produce too many free radicals, which sends it into suicide mode.



Usually, cells consume oxygen and glucose to produce the energy molecule ATP. Below, what happens to a cell when cardiac arrest cuts off the oxygen and the body is resuscitated, either normally or cooled.

**WARM**

**COOLED**



**Calcium**

When the cell's ion pumps shut down, the cell immediately begins hoarding excess calcium ions and dangerous free radicals.



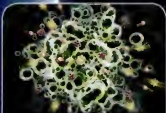
If doctors cool the patient after cardiac arrest, the cell's free-radical and calcium levels remain relatively low.



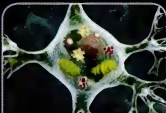
For reasons poorly understood, body-temperature cells with disrupted ion levels provoke the immune system to attack the cell.



With normal ion levels, the cell does not alert the immune system to any major problems when the oxygen returns.



Mechanisms inside the cell kick-start various processes that cause it to rip itself apart, essentially committing suicide.



The chilled cell is able to withstand the shock of restarting cellular metabolism, and it eventually recovers function.

they recommend the treatment for only a subset of patients—those who experience ventricular fibrillation (one of four forms of cardiac arrest) and collapse outside of the hospital—because already hospitalized patients tend to be sicker, so cooling them is riskier. Perhaps as a result, few doctors seem to be using the technique.

"It seems like a good idea, but there are so many variables," says Barco's cardiologist, Jonathan Gornberg, who, despite working with Becker and Abella at Penn, still seems uncertain about hypothermia. If a patient's heart has stopped for more than a certain length of time, is he still worth cooling? Penn's limit is an hour; much longer than that, and severe brain damage is difficult to avoid. If a patient wakes up after resuscitation and seems OK, should he be sedated again for cooling, since more sedation can also pose risks? Penn says no. The list goes on. "When the science is clear, there's one answer, and that's what you do," says Abella, now the hospital's clinical-research director. But that's not the case with hypothermia yet, so each hospital has to develop its own protocol. Even Penn cools only about 25 cardiac-arrest patients a year.

When Barco was brought to Penn from the Children's Hospital, the ER doctors immediately called the cardiac-care unit so that nurses could ready the cooling equipment. The unit also had to find a nurse who wasn't busy and could spend the entire night in Barco's room in case something went wrong.

And a lot can. In the early stages of cooling, Barco's heart wasn't pumping strongly enough. The nurses kept her on blood-pressure medications and reduced her saline, because when the heart is not pumping properly, fluid can collect in the lungs. If her body temperature had slipped below 86°, her heart could have immediately failed.

Becker and Abella are now working to address at least some of the practical resistance to hypothermia by designing studies to determine the most effective ways to cool. If the parameters are more clear-cut, the protocol more established, they believe it will be easier for hospitals to adopt. Yet they may have just dug themselves a deeper hole. Their latest research, which indicates that patients may be bet-

ter off if doctors begin cooling even *before* they restart the heart, will require more precision and an even greater trust in the treatment. How long will a doctor or EMT really let someone lie there with her heart stopped while he gets the ice ready?

#### AN IV SLUSHEE

On May 20, 1999, 29-year-old Anna Bagenholm was skiing with friends near Narvik, Norway, one of the most northerly towns in the world. A little after 6 p.m., on a path down a waterfall gully, she crashed and fell headfirst into a river. Her body wedged between some rocks and overlying ice; fortunately, she found an air pocket so she could breathe. Her

friends found her almost fully immersed underwater. But they couldn't get her out.

Ten minutes passed as Bagenholm struggled in the icy water. Twenty. Thirty. After 40 minutes, her body went limp—either she had drowned or the cold had stopped her heart. When the rescue team arrived at 7:40, they cut a hole in the ice and took her body out. Her temperature was 57.9°. They inserted a breathing tube and began continuous CPR. Her heart wouldn't restart, but pumping would at least get some oxygen to her organs.

An hour-long helicopter ride brought Bagenholm to the Tromsø University Hospital, where she was put on a heart-lung machine that breathed and pumped



**COOL DOCS** Lance Becker [left] and Ben Abella [right] of the Penn Center for Resuscitation Science now believe that doctors should cool patients *before* restarting the heart.



# "HYPOTHERMIA IS CHANGING THE BOUNDARIES FOR WHEN WE CONSIDER SOMEONE LOST."

**LUCKY LADY** After emergency-room clerk Pam Barco's cardiac arrest, doctors cooled her body to 91° for 24 hours. She recovered with no brain damage.



blood for her as she rewarmed. At 10 p.m. her heart started beating regularly on its own. By morning, her body was back up to normal temperature. Doctors sedated her for another three days and then slowly took her off the drugs. Eventually, she opened her eyes. She was alive and responsive, her brain virtually undamaged despite more than an hour without oxygen. After four months of rehabilitation, she went back to work.

Becker read Bagenholm's story in the medical journal the *Lancet* in January 2000, while he was deep into his own hypothermia research. He was stunned at how long she had survived without oxygen, but the variable was clear: Bagenholm was cold before her heart restarted. "It was one of the stories that exemplifies that there is great potential for [hypothermia] if we could figure out how to use it in an optimal way," Becker says. He and Abella now think "optimal" means "sooner."

In a study they published in 2007, the pair showed that mice

in cardiac arrest were more likely to survive if the experimenters waited to resuscitate them until after cooling had started. It was a provocative finding, because it suggested that the damage caused by a few extra minutes of oxygen deprivation is mitigated by getting a jump start on the cooling. The faster doctors can cool a patient, the fewer cells will die as they're reperused.

With the help of postdoctoral engineer Josh Lampe, Becker and Abella have designed a machine that uses IVs to flush the body with an ice-water saline mixture—"like a slushie, a slurpee, a margarita," Lampe says. The machine makes its slurry on demand and should drop a person's temperature to 91° in two hours, versus the eight it takes now. If things go well with their first prototype, which they're currently testing on pigs, Becker and Lampe will apply for FDA approval to use the machine on cardiac-arrest patients in a clinical trial. It should be possible, Lampe says, to make it portable. "Dream comes true, it's in an ambulance and the EMT does it," he says.

## CHEATING DEATH

Back in the cardiac-care unit, Barco was finally rewarming after 24 cold hours. The cooling wraps and cold saline were gone. Nurse Dana Bower was carefully watching Barco's vital signs during the eight-hour process for signs of "rewarming shock," when blood pressure drops suddenly and mysteriously. Once Barco was back at 98.6°, Bower removed her breathing tube and stopped giving her paralytic drugs and sedatives. Doctors also checked her heart rhythm with an electrocardiogram, but it was irregular. Afraid her heart was failing, they told her family that she might need a transplant. No one knew yet how her brain was faring, either.

Barco remained unconscious for four days. She started having problems breathing, so the breathing tube went back in. She fluttered in and out of consciousness for a couple days. She started grabbing her breathing tube to try to pull it out. Doctors had to put her in restraints.

Eventually, Barco awoke for hours at a time. At first, she would talk to her kids but forget the next day what she had said. As she improved, though, doctors found no lasting brain damage. They removed the breathing tube and implanted a defibrillator in her chest. She left the hospital three weeks later.

Slowly, the weight of what had happened to her settled in. Barco realized that she had literally been within feet of certain death. If she had collapsed somewhere where people couldn't have found her, she might be gone. "I could've been in the bathroom, I could've been anywhere," she says.

Abella believes that the more doctors learn to use hypothermia, the less of a death sentence those circumstances will be. In the past, doctors refused to bring back patients who had been clinically dead for more than an hour because they assumed that the brain damage would be debilitating. Now "hypothermia is beginning to change the boundaries for when we would consider someone lost, or beyond the hope of resuscitation," Abella says. "Death was death. But it's increasingly evident that even after the heart is stopped, a lot of biological activities are going on in the brain, heart and other tissues—so the tissues aren't dead. It's exciting, it's really tremendous, but it's really humbling."

Melinda Wenner is a freelance writer in Brooklyn, New York.



# Flying the Coal-Fired Skies

BY CATHERINE PRICE  
ILLUSTRATION BY JOHN MACNEILL

The Air Force has an ambitious plan to wean American aviation off oil. But will the cure be worse than the disease?

**IN THE NOT-SO-DISTANT FUTURE**, cars could run on electricity, power plants on wind and solar energy, and city buses on zero-emission hydrogen fuel cells. But airplanes? Those just might run on coal.

Yes, coal. The U.S. Air Force wants to create a synthetic-fuel industry that, unless something better comes along, will mine America's massive coal supply (we have more than a quarter of the world's known reserves) and turn it into enough jet fuel for half its domestic operations to run on a 50/50 blend of synthetic and regular fuel by 2016. By the Air Force's logic, it has no choice. It uses more fuel than all the other branches of the military combined, burning through 2.5 billion gallons of the stuff in 2007 alone—10 percent of the total used by the entire domestic aviation fuel market—at a cost of \$5.6 billion. And although oil prices have dropped in recent months, no one expects the relief to last indefinitely.

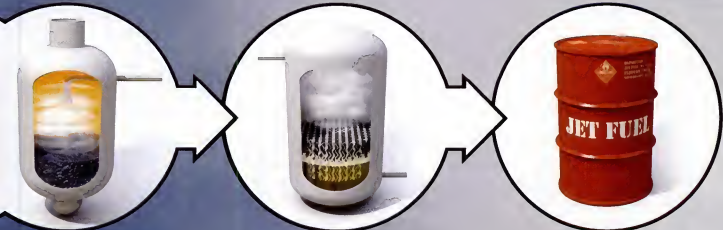
Yet alternative fuels for aviation are hard to come by. The Air Force says it's open to all sources of power for its fleet, but according to former assistant secretary of the Air Force William Anderson, petroleum, natural gas and coal are our only



Take coal...

### THREE KEY FACTS

- 1** The Air Force uses more fuel than any other branch of the military—2.5 billion gallons in 2007 alone.
- 2** It plans to run many of its planes on a blend of synthetic jet fuel, most likely made from coal, by 2016.
- 3** But the plan, which could result in new coal mines and twice the carbon emissions, is currently illegal.



2. Steam it to form "syngas"...

3. Expose that to catalysts...

4. And voilà: jet fuel

current options—and when you look at the U.S.'s resources, the choice is clear. "We're not the largest holder of oil reserves, so that's not a good option," he says. "We're not the biggest holder of natural gas. But we are the Saudi Arabia of coal." So the Air Force is doing its best to spark a domestic fuel industry that would be devoted, most likely, to digging new coal mines and building the country's first major coal-to-liquids (CTL) plants. To make the market bigger, it wants to convince the other branches of the military and even domestic airlines to run their fleets on liquefied coal, too.

From a purely martial perspective, the strategic benefits of this plan are obvious: The U.S. would use far less oil imported from countries it doesn't get along with. But there are problems, like the fact that the plan could generate twice the carbon dioxide emissions of current fuels—making it, thanks to a special clause in the 2007 energy bill, illegal.

**ONE GOOD THING** about transforming coal into jet fuel is that we know how to do it. In the 1920s, German scientists figured out a method for turning raw materials such as coal and natural gas into liquid fuel. It essentially involves steaming the coal to produce a hydrogen-and-carbon-monoxide gas, and then, through something called the Fischer-Tropsch process, exposing that gas to a series of catalysts to convert it to a liquid fuel. Hitler used the technique to power Germany in World War II, and during apartheid, when South Africa was facing embargoes, its government tweaked the process so that it could produce jet fuel as well. Once you've got the fuel, it's just a matter of proving that your planes can run safely on it. The Air Force has certified the B-52 and C-17 for unlimited use of a 50/50 synthetic fuel blend; has tested its B-1 Bomber, F-15, F-22 and KC-135; and aims to certify its entire fleet by 2011.

CTL proponents, aware that coal has an image problem, fend off criticism by saying that the fuel is actually "greener" than jet fuel made from petroleum. What they mean is that during the gasification process, jet fuel from coal is scrubbed clean of particulate emissions as well as sulfur dioxide and nitrogen oxide—the stuff that causes acid rain—so it is in one sense cleaner to burn. But that leaves out a crucial bit of information: Between mining the coal and burning the




resulting jet fuel, coal-to-liquids fuel produces twice as much CO<sub>2</sub> as the existing petroleum-derived fuel. The potential effect of creating a market for CTL fuels is frightening enough to environmentalists that last year Representative Henry Waxman, who now heads the House Committee on Energy and Commerce, added a clause to the 2007 energy bill—Section 526—prohibiting the U.S. government from spending taxpayer money on fuels that emit more greenhouse gases than the fuels we're already using.

That hasn't stopped the Air Force from moving ahead with its plan—it simply says that the companies that produce the fuel will have to figure out a way to comply with Section 526. So while lobbyists for both the coal and petroleum industries work aggressively to get Section 526 repealed, potential CTL suppliers are looking into technology that could, theoretically, clean coal-based jet fuel enough that it's the greenhouse-gas equivalent of petroleum.

There are a few ways to get there, none of them easy, including recycling CO<sub>2</sub> by running it back through the Fischer-Tropsch process to produce more fuel (after all, carbon dioxide has carbon in it, the same energy source as fossil fuel), using the CO<sub>2</sub> to grow oil-producing algae, or turning the carbon into usable industrial gases. The Air Force estimates

**THE BEST-CASE SCENARIO: COAL-BASED JET FUEL EMITS THE SAME AMOUNT OF CARBON AS TODAY'S JET FUEL. BUT THE BEST-CASE SCENARIO REQUIRES TECHNOLOGY THAT'S AT LEAST A DECADE AWAY.**





**GAS-GUZZLERS OF THE SKY** The Air Force flies some 51,000 aerial refueling missions a year in support of aircraft like the F-16 Falcon [right] and the B-2 Spirit stealth bomber [facing page]. The B-2 can fly across the world in a single run as long as it's fortified with several hits from an airborne fuel tanker along the way.

that it will be at least a decade, however, before any of those technologies can be used at anywhere near a broad scale. More feasible is using  $\text{CO}_2$  for something called enhanced oil recovery—liquefying and pumping the  $\text{CO}_2$  into dying oil wells to push remaining oil to the surface. But the danger in that process is that it might contribute to the very problem it's trying solve, because the energy required for liquefaction will almost certainly come from carbon-emitting fossil fuels. Then there are long-term consequences to consider. Will the carbon dioxide leak out of the oil well? No one knows.

The same long-term concerns vex another oft-discussed solution: carbon capture and storage. Currently being done at several small demonstration plants outside the U.S., this process involves capturing the  $\text{CO}_2$  as it's released from the Fischer-Tropsch reactor (the part where the synthetic gas turns into a liquid fuel) and pumping it into formations underground—essentially sweeping it under the rug, where it may or may not stay. But according to Lowell Miller, director of the U.S. Department of Energy's Office of Sequestration, Hydrogen, and Clean Coal Fuels, the real challenge of carbon sequestration is the vast amounts of money it will take to make it work. University of Manitoba professor Vaclav Smil has estimated that sequestering just 10 percent of the world's 2005  $\text{CO}_2$  emissions would require more plants and pipelines than are used in the entire worldwide business of crude-oil extraction. And there are other setbacks. Last year the Department of Energy canceled the main feature of its FutureGen project—the creation of the country's first commercial-size coal-fired plant that would capture all of its carbon emissions—because it was so far over budget.

**ULTIMATELY, THE QUESTION** is this: Is it better to send American aviation down the road toward coal-based fuel without a clear idea of what to do about the extra carbon emissions, or to keep on burning billions of gallons of imported oil every year? The lack of alternatives makes this debate tricky. Finding renewable sources of jet fuel is "going to be tough, there's no doubt about it," says Tyson Slocum, director of the public-interest group Public Citizen's Energy Program. "You can't put solar panels on a jet airplane."

The problem can even make committed environmentalists soften a bit toward oil. Henry Henderson and Shannon Fisk of the Natural Resources Defense Council suggest that we scrap liquid coal entirely and invest in oil-saving technologies that we already have, like hybrid and electric cars and trucks. That could free up more oil for jet fuel, lowering its cost and buying time to search for sustainable alternatives.

Eventually, new biofuels that cut carbon without raising food prices could be the answer. Some companies are already working on them. Virgin Atlantic flew a jumbo jet from London to Amsterdam last year using a fuel partially derived from Brazilian babassu nuts and coconuts. Last September saw the launch of the Sustainable Aviation Fuels Users Group, a coalition of Boeing, the NRDC, and several other airlines and environmental groups that aims to encourage the development of low-carbon fuels. In the meantime, the American military might very well start powering its future using the hydrocarbon fuel of the past.

*Catherine Price's most recent article for POPULAR SCIENCE WAS "The Anonymity Experiment," last March.*

# NOW, MORE MPG WITH THE WORLD'S FIRST ECO-FRIENDLY SPARK PLUG



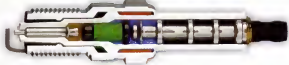
**Actually, it's called a pulse plug—here's why its technology should be in your engine.**

Until now, every gallon of gas you bought was ignited by a simple spark plug—an outmoded technology that has barely changed in 100 years. But now you can change to a new eco-friendly pulse plug that uses an advanced technology to make every drop of gas burn better and cleaner.

This new technology—with its eight patents—is based on plasma research supported by the world famous Sandia National Laboratories—and yes, that's *definitely* rocket science.



See the difference in technology: compare the cross section of a typical spark plug above, with that of the new pulse plug below.



**Here's how it works:** electrical energy from the engine's power coil is stored in the pulse plug's built-in capacitor. At the exact moment needed, that energy is released in an amazingly quick (two nanosecond), powerful, high-energy pulse.

**The result:** the improved combustion efficiency burns fuel sooner and more effectively, which means better fuel mileage, less CO<sub>2</sub> based emissions, and better overall drivability. For example, here is the result of a recent, highly-controlled fuel consumption lab test:

#### 2007 Toyota Prius



#### Test results:

- 4.4 more MPG
- Reduces CO<sub>2</sub> by a quarter-ton annually†

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# HOW 2.0

TIPS, TRICKS, HACKS AND DO-IT-YOURSELF PROJECTS



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Making tungsten carbide at home



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Build lights to keep plants thriving over the winter



**70**

Go beyond Google for better Web search results

**YOU BUILT WHAT ?!**

## THAR SHE BLOWS

AN EIGHT-CYLINDER SNOWBLOWER TAKES ON WINTER IN CANADA

**ALL CLEAR** Metal fabricator Kai Grundt adorned the front of his snowblower with a tribute to his favorite magazine.

When Kai Grundt announced his decision to build the ultimate snowblower from a discarded V8 engine, a friend of his just laughed. So a year later, instead of showing his buddy the finished product, Grundt showed him what it could do. He buried the man's truck under a seven-foot-tall pyramid of snow. From two houses away.

Since Grundt, a metal fabricator in Muskoka, Ontario, started with the huge engine from his old Chevy truck, he knew power wouldn't be a problem. But the 800-plus-pound machine also had to be easy to handle. He didn't want the snowblower racing away when he revved the blades that suck up the snow—the V8's crankshaft spins them up to 6,200 rpm—so he chose to run its tank-like tracks via a different system. Powered by the 412-horsepower V8, a hydraulic pump feeds a pair of hydraulic motors that each turn one of the tracks. This allows him to give the blades a boost while keeping the massive machine moving at a safe pace. Using controls built into the handlebars, he can also turn one track forward and the other in reverse, spinning the rig in place.

Grundt is now designing a kit to let others build their own driveway-clearing monster, and this winter he hopes to set a Guinness world record for a brand-new category: long-distance snowblowing. He figures he'll clear 100 feet easily. —GREGORY MONE

(SEE HOW IT WORKS, NEXT PAGE)



# ALL NEW MON DAYS

## DESTROYED IN SECONDS

Planes collide,  
tornadoes strike and  
things go 'BOOM!'

**8PM**  
E P

## ONE WAY OUT

Will escape artist  
Jonathan Goodwin  
get out or get hurt?

**9PM**  
E P

## MAN VS WILD

Bear's back and  
putting a smackdown  
on Mother Nature.

**10PM**  
E P

## HOW THE V8 SNOWBLOWER WORKS

● 1 YEAR ● \$12,000

### ● BLADES

The machine has an extra-wide auger and large customized blades to grab and throw the snow. The engine can spin the blades nearly twice as fast as a conventional snowblower, enabling it to blow thick snow a long distance.

### ● COMFORT

Moving snow can be a frigid business, so Grundt installed a remote-start system to get the machine warmed up before he steps outside. The blower doubles as a heater, too. He faced the engine's radiator toward the back; an electric fan blows excess heat right at his legs. He also built a hollow handlebar and rigged it such that the engine's coolant flows through. The fluid heats the bar, keeping his hands toasty in the dead of winter.

### ● NOISE CONTROL

Twin, custom-designed pipes ensure that there's no exhaust streaming into the driver's face during operation. Grundt also gave the pipes a series of interior channels that reroute and slow down the expelled air, dampening the noise. Cutting down on the decibel level keeps the neighbors happy.

### ● DURABILITY

Early models of the snowblower used rubber tires, but Grundt decided to switch to tracks instead because the wheels couldn't bear the weight or the cold. Even the dashboard-mounted gauges were chosen for toughness—he installed heavy-duty boat gauges, which are better equipped to withstand the freezing, snow-filled Canadian air.



**PLENTY OF JUICE** The V8 can spin the snowblower's blades at more than 6,000 rpm.



**PANEL DISCUSSION** A driver's-eye view of the machine's heavy-duty controls



## 5 THINGS YOU CAN DO TO

### MAINTAIN FOCUS

#### 1 TAKE A GUILT TRIP

Find out where your day went. RescueTime ([rescuetime.com](http://rescuetime.com)) logs the number of minutes that you've spent on every site and application. You can then view the data in charts and graphs to spot the biggest focus-breakers.

#### 2 DISABLE THE WEB

Quit your Web addiction cold-turkey by downloading Browser Timer (Windows; [codejacked.com](http://codejacked.com)) to shut down your browser after a specified amount of surfing time. Or try Freedom (Mac; [ibiblia.org](http://ibiblia.org)), which temporarily kills your Internet connection altogether. (In a pinch, you can bring it back by restarting your computer.)

#### 3 BLACK OUT

Once you've shut off the Net, cure your remaining ADD with Clutter Cloak (Windows; [tomcooke.me.uk](http://tomcooke.me.uk)) or Think (Mac; [freeverse.com](http://freeverse.com)). Both cut distractions by covering everything on your screen in solid black except the window you're working in.

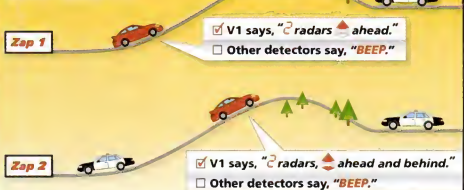
#### 4 KEEP TIME

Enter the task you need to work on, and start the clock on Time Tracker ([formassembly.com](http://formassembly.com)). The tool keeps you locked in by creating timed work/break cycles. If you want to put a dollar value on your concentration, try Work Timer ([worktimer.co.uk](http://worktimer.co.uk)), which shows a running tally of how much money you're owed for the time you've dedicated to a particular job.

#### 5 MUTE THE OFFICE

Don't let yakkity co-workers get you out of your zone. ChatterBlocker ([chatterblocker.com](http://chatterblocker.com)) pumps a fine-tuned mix of ambient sounds, like rain, birdsong and gentle chords, into your cubicle to drown out the gabbing.—ERIC MIKA

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# BUILDING A TOUGH BIT

MAKING A TUNGSTEN CARBIDE TOOL THAT CAN CUT NEARLY ANYTHING

A visitor recently told me he remembered as a child watching his dad mixing dark powders and heating them in a graphite mold in the basement with an acetylene torch. He believes his father was making tungsten carbide tools from scratch. I'd never heard of anyone doing that, and the story sent me on a weeks-long quest to find out if it was even possible.

Tungsten carbide is used to make high-end saw blades and drill bits. It's harder than just about anything short of diamond. A matrix of cobalt metal holds together small particles of the super-hard tungsten carbide, similar to the way glue holds the grit

on sandpaper. But those bits are made in factories using inert-atmosphere furnaces and massive, hot isostatic presses that fuse the powdered ingredients. You couldn't seriously do it in your own basement. Could you?

A friend in the tungsten business put me in contact with a metallurgist at bit-manufacturer General Carbide who said, "No way, not possible, forget about it." But after I passed along every detail of my friend's story, the expert finally agreed that it *might* be possible.

A quick visit to eBay for materials, and I was ready to give it a shot. I pressed a mixture of 10 percent cobalt and 90 percent tungsten carbide powder

lightly into a mold I'd made from graphite (just about the only material able to withstand the 6,000°F torch) and played the acetylene flame over the mold for a couple minutes, trying to channel the spirit of that long-ago basement.

And it worked! That's all it took to produce a credible, if crude, pellet of solid tungsten carbide. I slowly ground it on a diamond wheel and brazed it to a steel shaft, then used it to cut pretty curls of aluminum on my lathe. Few things are more satisfying than tackling something you thought was impossible and getting it done in 10 minutes.

—THEODORE GRAY



**A CUT, ABOVE** The homemade bit and shaft, cutting aluminum on a lathe



**BIT PARTS** The homemade bit and a commercial bit (blue), next to tungsten carbide and cobalt powders. Solid tungsten carbide is totally safe, but in powdered form it's toxic and should be handled with care.

**UNDER FIRE** Tungsten carbide and cobalt powders roasting under an acetylene flame at around 6,000°F. It's so bright that it can be viewed only through welding goggles.

ACHTUNG!

Theodore Gray is trained in lab safety. Don't try this at home. See more of Gray's work at [periodictable.com](http://periodictable.com).



BUILD IT

# SUNSHINE STICKS

CREATE A LIGHT SYSTEM TO KEEP HOUSEPLANTS THRIVING DURING THE SHORT DAYS OF WINTER

As you huddle inside your home this winter cursing the gloomy darkness, remember that you're not alone: The season has an even worse effect on your plants. Many common houseplants need far more hours of light than they get naturally in the middle of February, especially if they don't have direct exposure to a sunlit window. Although the incandescent and fluorescent bulbs most people have in their homes will keep plants alive, they don't emit light that's within the temperature range necessary for optimal, or even adequate, foliage growth in light-hungry plants.

Specialized grow lights that closely mimic the sun's rays are a better solution,

but you can get the same effect with special LEDs that are also brighter, cheaper and last far longer. These bulbs actually work best as a supplement to sunlight during the day; however, they'll also provide enough light after dark to ensure that your plants get the 12 to 18 hours a day they need to thrive. We connected three inside a clear plastic tube, a "light spike" that you can stick right into the pot for direct exposure, and added a controller that adjusts the brightness. Or you can string together multiple spikes to cover several plants at once. The system should keep your plants in great shape until springtime—just don't forget the water. —DAVE PROCHNOW

## DIY GROW LIGHTS

- TIME: 6 HOURS
- COST: \$57.50
- EASY ○○○○ HARD

For more information and a parts list, go to [popsci.com/lightspikes](http://popsci.com/lightspikes).

### 1 Assemble the control box

Mount the power-conector jack inside the box and the 10-position header, which connects the spikes to a wall outlet, on the side. Attach pins from the header to the jack's terminals. Optional: To add a circuit to the box that can vary the LEDs' intensity, follow the schematic at [popsci.com/lightspikes](http://popsci.com/lightspikes).

### 2 Build the light spikes

Cut the wire inside the LED design kit into five equal lengths. Attach the red wire to the red connector, and the black wire to the black connector, on each LED strip. Slip each strip inside a clear tube, and seal it so it's watertight.

### 3 Add the two-position connectors

These connect the spikes to the box. Attach each one to the red and black wires from each LED strip.

### 4 Let the sun shine in

Press a spike into your plant container. Keep all wiring, electrical connections and the LED strips away from soil and moisture. Plug the spikes' two-position connectors into the control box's 10-position header, and connect the power supply to turn the LEDs on. If applicable, adjust the control circuit.



**ASK A GEEK**

**ASK A GEEK** IS GOOGLE THE ONLY TOOL I NEED TO SEARCH THE WEB?

Not if you want the best results.

Google's index reached a trillion pages last year, but that doesn't mean it (or other large search engines, like Yahoo) will always understand the exact intent of your search and yield results that have the information you really want.

If Google isn't coming up with quite what you were looking for, you may want to turn to other people for help instead of relying on algorithms. On *mahalo.com*, guides provide reviews and comments on Web sites to

help bring up more relevant results. You're also likely to find deeper content by using topic-specific search engines known as vertical-interest sites, such as [snooth.com](http://snooth.com), a search engine and community site for wine lovers, or [organizedwisdom.com](http://organizedwisdom.com), a search site for health information. Besides narrowing down the field, vertical-interest sites often offer useful services as well.

KEVIN M. RYAN is chairman of the advisory board of the Search Engine Strategies conference series.

**GOT A QUESTION FOR OUR GEEK CHORUS? SEND IT TO US AT [h2o@bonniercorp.com](mailto:h2o@bonniercorp.com).**

Seamlessweb.com, for example, not only includes menus and restaurant reviews but also lets users searching for lunch order it online.

Keep in mind that many smaller engines require you to submit some personal information so they can optimize search results. And of course, to find these types of sites in the first place, you'll probably have to start with some Googling.



## Need Auto & Body Parts at Rockin' Prices?

I stumbled across RockAuto.com by way of some Nissan message boards for a DIY project I was researching. Three times I've ordered from RockAuto and this company is absolutely excellent to deal with! They're right on the ball, timely delivery, excellent prices, and overall great web site (love how parts ordered lets you link right to a tips Wiki for the specific job).

I highly recommend them to friends and others. They set the standard for web-based sales and services; now if only traditional brick and mortar stores would be this good."

*Customer testimonial from an independent, third-party survey.*

## Price Comparison

1999 Ford F-150	Cylinder Head	Gasket Set
Parts Store	Part Brand	Price
RockAuto	Fel-Pro	\$147.79
O'Reilly	Fel-Pro	\$179.99
Autozone	Fel-Pro	\$182.99
Advance	Fel-Pro	\$183.99
Checker, Schucks, & Kragen	Fel-Pro	\$183.99
NAPA	Fel-Pro	\$219.00

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- ✓ Fast Shipping
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1. Remove keys from the keyboard, and cut off the excess plastic on the back.
2. Widen the hole in the back using a drill, and put a dab of glue in it.
3. Insert a small pushpin into the hole, pointy end out.

\*For more details, search for user "noahw" on [instructables.com](http://instructables.com).

## RETRO TRICK OF THE MONTH



## THE VIDEOTAPE USB HUB

VHS tapes are a dying medium, but German student Harald Mueller found a way to give one new life by using it as a case for his USB hub. He removed part of the reels to make room for the hub, cut holes on the side of the tape to expose the USB ports, and modified the hub so he could power it from his computer.

As a finishing touch, he added blue LEDs inside, giving it a space-agey glow that just screams obsolete '80s technology.

Next time,  
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## WEB SITE OF THE MONTH

## HOWCAST.COM

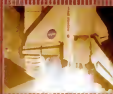
Welcome to the ultimate collection of how-to videos. Howcast offers thousands of original shorts providing easy-to-follow steps on doing just about anything you can imagine. Some videos are self-consciously frivolous ("How to Make Green Beer") and some downright absurd ("How to Successfully Beg for Money"), but there are also plenty of practical topics, like setting up a wireless network and diagnosing problems with your car.



How To Reset Jet-Lag

How To Improve Your Car

How To Improve Your Car



75

How does the space shuttle get by on just one megabyte of RAM?

## SOMETIMES YOU JUST NEED TO KNOW

**DUST BUSTER** Cosmic dust clouds, like these in the Carina Nebula, could end life on Earth.



## ASK A CONTRIBUTING TROUBADOUR

## Q How do I become an Internet rock star on the cheap?

**A** Chances are you've got a more advanced recording studio in your laptop than the Beatles had when they made *Sgt. Pepper's*, so record your music yourself. Then build an Internet home that can grow with your entourage. Skip the cookie-cutter MySpace stuff and get a long-fledged content-management system like WordPress or Drupal, which will allow you to build your empire as you go: a blog, forums, photos, videos—all in one place that you control. And make sure it can support a digital music store so you can sell your own MP3s. I use PayPal Micro-payments because the commission structure is better for small purchases than with iTunes or Amazon. If you don't know HTML or PHP,

find a sucker... er, a fan to build it for you.

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Promote yourself on Twitter, broadcast live shows on Ustream, use Creative Commons licensing to encourage folks to make

new content, like music videos, with your music. Send out a million pieces of yourself to interact with potential fans. If they're out there, they'll find you—and hopefully sometime after that, give you money. Above all else, keep it simple and honest. Leave the 24-piece orchestra out of it (unless you're a 24-piece orchestra).

Extra credit: Hire a camera crew to film one of your shows and release it as a combination DVD/live CD called "Best. Concert. Ever." on February 10 for only \$20. Actually, hold off on this one. I'll let you know if it works for me.

*PopSci contributing troubadour Jonathan Coulton quit his programming job in 2005 to become a full-time musician. Find him at [jonathancoulton.com](http://jonathancoulton.com).*

## What is the worst possible disaster that could befall Earth?

Texas-size asteroids make for exciting summer blockbusters, but when it comes to long-term damage, they're not the most menacing threat out there. Lurking at the edge of our galaxy are giant molecular dust clouds—agglomerations of hydrogen gas, small organic molecules and minerals—roughly 150 light-years across. If our solar system hit one, it would take 100,000 years to pop out on the other side.

During that time, the dust would accumulate in the atmosphere and block out nearly all light from the sun. The oceans would freeze over and terrestrial plants would die off, leading to a near-total extinction of life, says Alexander Pavlov, a NASA-affiliated astrobiologist at the University of Arizona. The good news? We probably won't hit one for at least 40 million years.

Look closer to home for a less catastrophic disaster-starter, Pavlov says. Underwater volcanoes could spew hydrogen sulfide and carbon dioxide into the atmosphere, which many scientists think caused the worst mass extinction in history 250 million years ago, when 90 percent of all marine species and 70 percent of land animals died. But there's an upside even to this: Bacteria and other microorganisms thrive in these conditions, so there's a good chance of life hitting the restart button.—CHRISTOPHER MIMS

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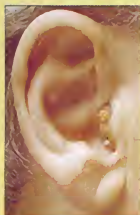
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**VINTAGE TECH** The shuttle's pea brain is smart enough to control a launch.

## Does the space shuttle's computer really run on just one megabyte of RAM?

It's true: The brain of NASA's primary vehicle has the computational power of an IBM 5150, that '80s icon that goes for \$20 at yard sales. According to NASA and IBM, the shuttle's General Purpose Computer (GPC)—which controls, among other things, the entire launch sequence—is an upgrade of the 500-kilobyte computer the shuttle flew with until 1991.

Such an antiquated computer works just fine for NASA. The shuttle doesn't need to support a powerful graphics engine or create PowerPoint presentations or store MP3s. It focuses entirely on raw functions—thrusters on, thrusters off—which, though mathematically complex, don't require the juice that a user interface like Windows calls for. The GPC has flown so many missions with hardly a hiccup that there's no reason to replace it, even if it is just 0.005 percent as powerful as an Xbox 360. Besides, a complete overhaul would be horrendously expensive. The GPC's software would have to be completely reconfigured for a modern computer and tested until proven flawless.

For proof that you shouldn't fix a space computer if it ain't broke, consider Russia's Soyuz space capsule, which since 1974 has been running Argon-16 flight-computer software with just six kilobytes of RAM. In 2003 the Russians rewrote some of the spacecraft's software, which experts suspected led to its subsequent crash-landing in a desert in Kazakhstan.—C.M.

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CONTINUED FROM PAGE 431

# WINGMAN

twists the motorcycle-grip throttle at his side. Then he arches his back a little and, if all goes well, he's climbing.

The timing is based on his perception of how strong the wind feels against his suit. If he guns it and the fuel doesn't reach the turbines at precisely the same millisecond, the control system would misinterpret it as an engine failure. In that case, parallel turbines would shut down to prevent a spin, a crucial failsafe JetCat added.

The biggest problem with his current wing is that it's slightly warped, such that when it stalls, it tacks violently into a rightward spin. It happens very fast, without warning, and the videos from his helmet camera are nauseating to watch. Stefan von Bergen, the engineer at Ruag Aerospace who ran the wind-tunnel tests, marveled that Rossy could control the wing at all, given that "it has no

natural tendency to maintain a certain altitude." He says, "You can compare this to riding a wild horse." So now Rossy and his crew are building a newer, better version. Rossy wants something narrow enough to fit out the door of a Pilatus Porter, about six feet wide, so he can dispense with the weight and complication of the mechanism to unfold the wing. He's already gliding with a rough-hewn prototype to see how the shape handles, while Ruag models and simulates the aerodynamics.

The final version will probably carry a delta shape and compensate for the reduced lift of the smaller wings with more-powerful engines. JetCat is working on a pair of massive turbines with 154 pounds of thrust apiece (rather than four with 48 pounds), which means that if Rossy can bring the wing in at 308 pounds including his body weight, getting the wing down to a 1:1 power-to-weight ratio, at least on paper he'll be able to fly straight up, Superman-style.

[CONTINUED ON PAGE 79]

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6. Becoming a ROM enthusiast and trying to persuade friends.
7. Being ignored and ridiculed by the friends who think you've lost your mind.
8. After a year of using the ROM your friends admiring your good shape.
9. You telling them (again) that you only exercise those 4 minutes per day.
10. Those friends reluctantly renting the ROM for a 30 day trial. Then the above cycle repeats from point 5 on down.

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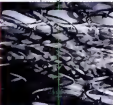
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(CONTINUED FROM PAGE 76)

# WINGMAN

Before he does that, he must develop a rocket-powered chute that can deploy safely at 600 rather than 2,600 feet. "Instead of three minutes without plan B, I will have about 15 seconds," he explains. "So I will be not worse than a one-engine plane at takeoff. And then the risk is OK to try."

His immediate goal is to perform aerobatics with the new wing in another public demonstration, perhaps as early as next year at the Grand Canyon, where spectators could watch from the rim as he flies at their level. It's difficult to see Rossy fly live otherwise, and the witnessing is important to him; he doesn't want fans so much as he wants believers. *Not only can humans fly, they can soar.*

But I wonder how high he'll go. How close can he get to his ever-evolving dream without killing himself? Plenty of pioneers before him died trying to fly in one way or another, and surely the difference between them and him isn't merely strength of conviction. For all Rossy's assurances about backup plans, methodical testing and safety imperatives, sometimes the dream comes frighteningly close to snuffing out reality. He tells me about another of his close calls, this one in the lead-up to the Channel feat during a test flight in

Empuriabrava, Spain. Again in a spin, he put his hands up next to his ears, a position that he'd discovered often solved the problem. Except this time it didn't. He was fast approaching his minimum altitude but didn't want to jettison the wing and risk damaging it, so he popped his chute with the turbines still running. Smoke and fumes billowed up under the canopy before he could kill the jets, disorienting him. He landed in a controlled crash with a 25mph tailwind. When he looked up, he saw that he was in a nature preserve: silent except for some rustling of leaves, a mare looking on and a few ducks gliding on a lake. "I'm coming down with my carbon-fiber, high-tech, four-engine thing, and I land on my knees in a perfect nature picture," Rossy says, laughing and shaking his head at the irony. "Who is wrong here? On the one hand, I realize I'm doing something totally unnatural. I know if I were a bird, I would have feathers. On the other hand, I'm human. And it's not only doing the wing, but it's a way for me to elevate personally, in the whole sense of the word. To create something, to discover something new."

*Eric Hagerman is a contributing editor at POPULAR SCIENCE. His most recent article, last September, was about traumatic brain injuries in soldiers returning from combat.*

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Our zone area heating concept saves money. Using individually controlled units, the SUNHEAT system provides heat only where and when it is needed for more control over area comfort and energy bills.

There is lower operating and maintenance costs than conventional heat systems and the SUNHEAT is virtually maintenance free. There is no unwanted changing of filters or high prices for replacements since our zone heaters have a lifetime washable filter. There are absolutely no burners to adjust or replace. Long-life industrial infrared commercial quartz tubes are replaced easily and inexpensively. A full three-year warranty, including the new commercial quartz tubes, protects the consumer's investment. The SUNHEAT does not remove humidity from the air! It actually helps maintain desirable humidity levels. Also, water does not readily collect on the windows as with conventional systems.

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Dr. Cutler is a biologist and President of Athena Institute, co-discoverer of human pheromones in 1986 (Time 12/1/86; Newsweek 1/12/87). Ph.D. from U. of Penn, post-doc Stanford, authored 35+ scientific papers, 6 books, and wrote the pheromone chapter in a medical textbook.

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Scientists studying the universe have concluded that its basic properties are uncannily suited for life. They say, "There are so many life friendly properties that physicists cannot dismiss them as mere accidents. Tweak the laws of physics in just about any way—in this universe anyway—and life as we know it would not exist—nor would we."



Richard W. Wetherill  
1906-1989

After reading that paragraph, ask yourself how are people treating our amazingly fine-tuned habitat? Answers might vary, but most would agree that it is often misused to serve human purposes.

This essay intends to draw people's attention to their nonconformance to a little-known law of nature, causing them untold physical, mental, and/or emotional misery as well as any disregard for the safety of planet Earth.

Early in the past century Richard W. Wetherill identified that natural law and presented it in a book entitled, *Tower of Babel*, published and on sale in January 1952. Its correction technique was copied by psychologists in the Philadelphia area, but the book's reference to a natural law of behavior was ignored.

Wetherill's epiphanies and a study of his behavior and that of many thousand others had revealed people's wrong attitude toward the realities of life. After eons of human efforts to quiet turbulent human affairs, they still cry out for solutions.

If we reason from the fact that this planet is the only place in the universe that supports life as we know it, Wetherill suggests the following:

Whoever or whatever created this perfectly constructed planet also created a law governing its inhabitant's behavior. Wetherill called it the *law of absolute right*: **Right action gets right results.** It defines right as what is truly logical, rational, and honest. As with creation's laws of physics, only by conforming to this behavioral law do people solve their problems and avoid further trouble.

It is well known that not conforming to natural laws results in trouble of one kind or another. By failing to take right action, people unwarily invite myriad problems and trouble that, sooner or later, cause each person's death. No argument here; death is what has

been happening from the beginning of human life to the present generation.

No claims are being made. We are presenting facts that can be verified by anybody observing the cause-and-effect sequence of human existence.

We think that this perfectly constructed universe calls for perfectly behaving occupants and that that result can be achieved when enough persons do their best to conform to nature's behavioral law mentioned earlier.

Wetherill often spoke of the need for a microcosm of a rational society to display right results for others to observe. The adult population of the United States of America could be that microcosm in our world population of over seven billion. Don't hesitate! The persons who are conforming to nature's law of behavior are enjoying the right results that the law promises.

*No instructions were given ancient peoples regarding a law of gravitation, but they learned to conform to it to stay out of trouble with the force of gravity. Please regard this public-service message as a wake-up call for readers to adapt their behavior to conform to nature's law of absolute right. Be assured, people's truly rational, honest behavior extends the beneficent intent of whoever or whatever created this life-friendly universe and us.*

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Like a picked flower cut from the source, we gradually wilt physically and mentally and become vulnerable to a host of degenerative diseases, that we simply weren't susceptible to in our early adult years.

Modern medical science now regards aging as a disease that is treatable and preventable and that "aging", the disease, is actually a complication of various diseases and pathologies, from everything, like a rise in blood glucose and pressure to diabetes, skin wrinkling and so on. All of these aging symptoms can be stopped and rolled back by maintaining Growth Hormone levels in the blood at the same levels HGH existed in the blood when we were 25 years old.

There is a receptor site in almost every cell in the human body for HGH, so its regenerative and healing effects are very comprehensive.

Growth Hormone first synthesized in 1985 under the Reagan Orphan drug act, to treat dwarfism, was quickly recognized to stop aging in its tracks and reverse it to a remarkable degree. Since then, only the lucky and the rich have had access to it at the cost of \$20,000 US per year.

Many in hollywood's glamour sets, who never seem to age like you or I, have a special secret to tell, and even space pioneer and US Senator John Glen stays vital with HGH.

The next big breakthrough was to come in 1997 when a group of doctors and scientists, developed an all-natural source product which would cause your own natural HGH to be released again and do all the remarkable things it did for you in your 20's. Now available to every adult for about the price of a coffee and donut a day.

GHR now available in America, just in time for the aging Baby Boomers and everyone else from age 30 to 90 who doesn't want to age rapidly but would rather stay young, beautiful and healthy all of the time.

The new HGH releasers are winning converts from the synthetic HGH users as well, since GHR is just as effective, is oral instead of self-injectable and is very affordable.

GHR is a natural releaser, has no known side effects, unlike the synthetic version and has no known drug interactions. Progressive doctors admit that this is the direction medicine is seeking to go, to get the body to heal itself instead of employing drugs. GHR is truly a revolutionary paradigm shift in medicine and, like any modern leap frog advance, many others will be left in the dust holding their limited, or useless drugs and remedies.

It is now thought that HGH is so comprehensive in its healing and regenerative powers that it is today, where the computer industry was twenty years ago, that it will displace so many prescription and non-prescription drugs and health remedies that it is staggering to think of.

The president of BIE Health Products stated in a recent interview, I've been waiting for these products since the 70's. We knew they would come, if only we could stay healthy and live long enough to see them! If you want to stay on top of your game, physically and mentally as you age, this product is a boon, especially for the highly skilled professionals who have made large investments in their education, and experience. Also with the failure of Congress to honor our seniors with pharmaceutical coverage policy, it's more important than ever to take proactive steps to safeguard your health. Continued use of GHR will make a radical difference in your health, HGH is particularly helpful to the elderly who, given a choice, would rather stay independent in their own home, strong healthy and alert enough to manage their own affairs, exercise and stay involved in their communities. Frank, age 85 walks two miles a day, plays golf, belongs to a dance club for seniors, has a girl friend again and doesn't need Viagra, passed his drivers test and is hardly ever home when we call - GHR delivers.

HGH is known to reverse Hemorrhoids, Autoimmune Diseases, Macular Degeneration, Cataracts, Fibromyalgia, Angina, Chronic Fatigue, Diabetic-neuropathy, Hepatitis C, Chronic Constipation, High Blood Pressure, Sciatica, helps Kidney Dialysis, and heart and stroke recovery.

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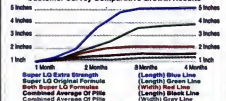
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## [AGING]

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## [CHINAIPHONE]

### Will Apple announce an iPhone launch in China by this March?

Chinese workers supply the world with a minor technological marvel that, so far, they cannot buy themselves: the iPhone. Rumors have swirled for months that the iPhone would come to China any day now—and still nothing. Recently, however, Apple posted a listing for an iPhone-related job in Beijing. Could that mean the people who make iPhones for a living might soon have a chance to carry their own?



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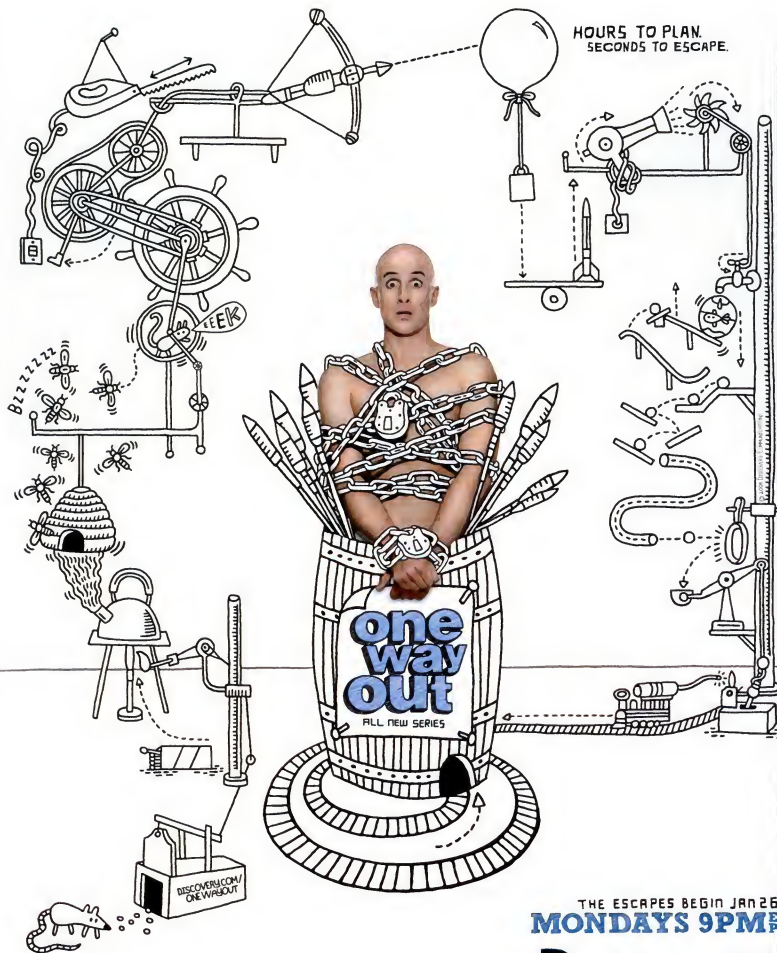
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